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Army Manual of
SANITATION

1926

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PREFACE

This volume has been compiled as an elementary manual of hygiene and sanitation suitable for the non-medical reader and is designed especially for regimental officers and other ranks.

The various types of sanitary apparatus and the construction of field sanitary appliances have been dealt with very briefly, as these are subjects in which no acquisition of book knowledge can replace practical instruction.

Barrack drainage has been omitted, as this subject is fully dealt with in other official publications.

In conjunction with this manual the following should be studied:—

King's Regulations.

Field Service Regulations, Vol. I, 1923:—Sections 27 (8); 89 (5); and 210 (8); and Chapter XXII.

Field Service Regulations, Vol. II, 1924:—Sections 98 (4); 133 (2); 144; 150 to 152; 153 (1); 156; 164 (6 and 7); and Chapter XIII.

Instructions in the Care of Barracks.

Management of Soldiers' Messing.

Elementary Physiology in its Relation to Hygiene.

Those in search of more advanced information will find it in the following official publications:—

Manual of Military Hygiene.

Memoranda on Medical Diseases in Tropical and Sub-Tropical Areas.

Medical History of the War, Hygiene of the War, Vols. I and II.

By command of the Army Council,

H. J. Creedy

THE WAR OFFICE,
2nd February, 1926.

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Tuberculosis—Influenza—Cerebro-spinal meningitis—Small-pox—Tetanus—Scabies—Inflammatory diseases of the skin — Malaria — Yellow fever — Phlebotomus fever — Plague —Typhus fever—Trench fever—Bilharzia disease—Scurvy—Heat stroke—Trench foot—Venereal diseases.

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CHAPTER I

INTRODUCTION

1. To the soldier the subject of the preservation of health in peace and war is of paramount importance. Many of the diseases which cause the greatest ravages in the ranks are due in a large measure to ignorance of the laws of sanitation—laws that cannot be broken with impunity.

2. The measures necessary to maintain troops in health concern not only the medical service, but are the business also of every officer, non-commissioned officer and man throughout the whole army. Such measures can be carried out with good effect only by those who have some knowledge of, and interest in the subject. Consequently, everyone must be conversant with the ordinary laws of health, must understand the scientific reasons for these laws, and must know how to put them into practice both in peace and war.

3. Thorough sanitary discipline is of prime importance in the prevention of disease. For example, during the American-Spanish war there was less sickness of a preventable type in the camps occupied by the regulars than in those occupied by volunteers; in other words, where the discipline was less strict preventable disease was more prevalent. Carelessness or neglect of the rules of sanitation is followed by the prevalence of disease as certainly as night follows day.

4. A very large proportion of the diseases of armies is preventable, and the importance of prevention becomes manifest when one considers the difficulties which masses of sick and disabled men throw upon an army in the field. As a rule, many more men are lost through disease than through enemy action. (Fig. 1.)

For example, in the Walcheren expedition of 1809 the deaths from disease were 347 per 1,000 of strength, and the number of men who were non-effective from sickness, practically at the same time, may be estimated as including the whole force.

During the Peninsular War three times as many men were lost by sickness as by wounds, and more than twice the strength of the whole army passed through the hospitals during the war on account of disease. In the Madagascar expedition the French lost one third of their force by deaths from disease; and the United States Army was decimated by sickness before it ever sailed for the area of operations, during the war with Spain. There are also instances of military expeditions being

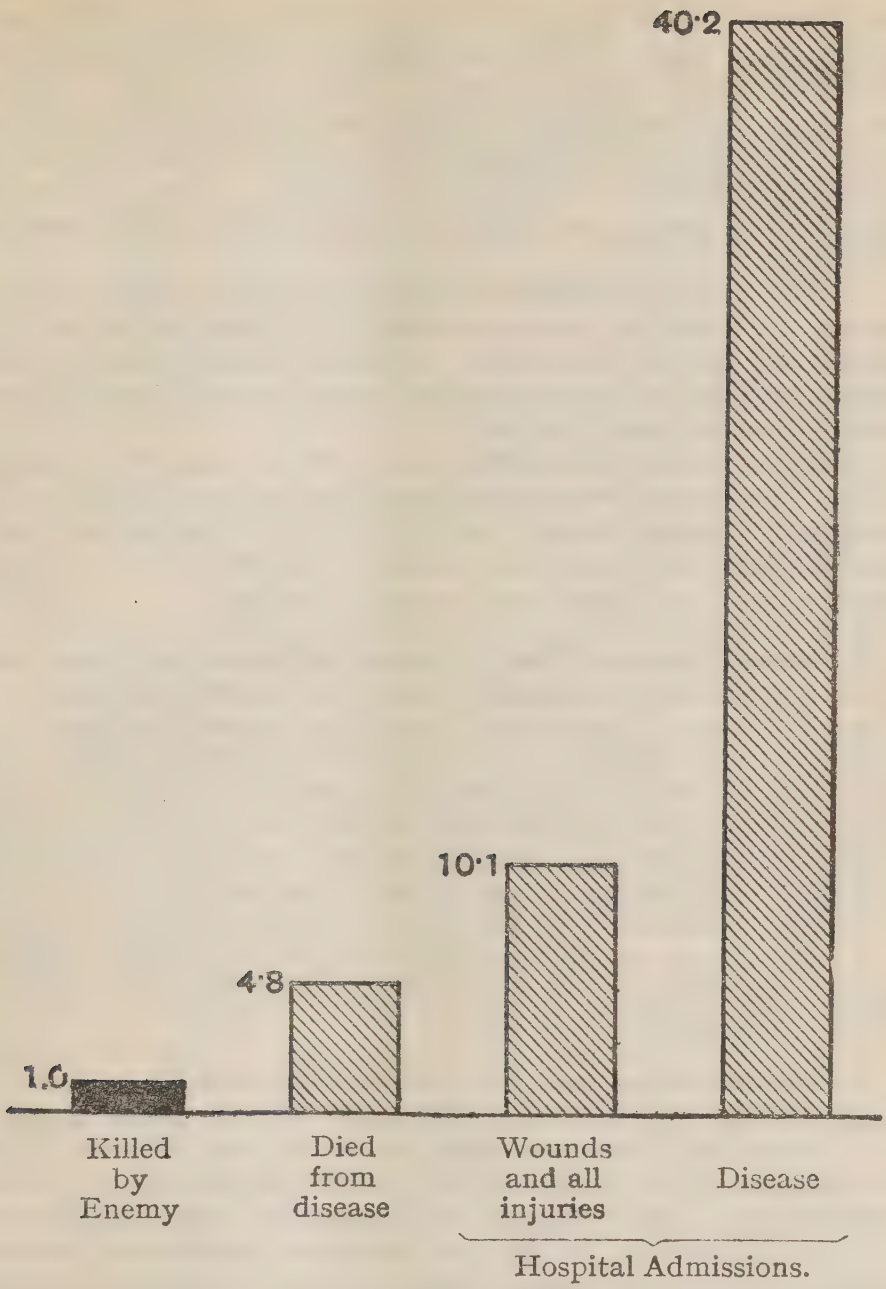


FIG. 1.—Ratio between sickness and casualties in British wars of last 30 years.

abandoned on account of severe attacks of disease in the camps of concentration ; and disease has frequently been not only the indirect, but also the direct, cause of surrender of garrisons to the enemy.

In the campaign in South Africa 69 men per 1,000 of the strength died from disease, and 746 per 1,000 of strength were at one time or other non-effective from sickness. For enteric

fever only there were 59,750 admissions and 8,227 deaths amongst all ranks. In these figures other continued fevers, some of which were probably paratyphoid fever, are not included. If this same heavy incidence had occurred in France the total number of admissions during the war for typhoid and paratyphoid fevers would have reached a total of 570,000 with 80,000 deaths, whereas there were only 6,807 cases with 260 deaths.

Gastro-intestinal diseases such as diarrhœa, dysentery and enteric fever are far more prevalent in an army in the field than in an army on garrison duty. Inoculation and general sanitary precautions have much reduced the danger, but it is one which must never be lost sight of.

Serious losses may also occur from malaria, undulant fever, influenza, cerebro-spinal meningitis, scurvy and beri-beri, under local and other circumstances; while occasionally epidemics of cholera, yellow fever, plague, typhus and small-pox have attacked armies.

5. In addition to these diseases, certain minor complaints with a practically negligible death-rate have played a very important part in reducing the striking power of armies in the field; trench fever, scabies or itch, inflammatory skin conditions, trench foot, frost-bite, heat-stroke, scurvy, indigestion, and dental caries may be included in this category.

Further, there are conditions of ill-health and lowered vitality, such as inevitably follow transgressions of the laws of health, conditions which may not result in actual sickness, but will always render troops not only less able to work, to march, or to fight, but also far less resistant to germs of infectious diseases.

6. In barracks, as in civil life generally, there are mechanical contrivances permanently fixed for the supply of pure water and for the removal of refuse and excreta. There is sanitary legislation, which is systematically and easily carried into effect; a staff of inspectors notes infringement of the sanitary law, so that the individual inhabitant does not have to think, and hence ceases to think, about the sanitary care of his dwelling and surroundings.

In camp and in the field troops have to perform for themselves most of those sanitary measures which in barracks or in civil life are done for them by others.

7. In an army in the field diseases of all kinds tend to be more prevalent than under conditions of peace, because:—

(*a*) Vitality is lowered or actual disease occurs through fatigue, exposure, unaccustomed climates, and occasionally scanty food or indifferent cooking.

(*b*) The above causes also lower the resistance of men to the invasion of germs of disease.

(*c*) Men are massed together and disease germs pass more easily from the sick to the healthy.

(*d*) Men accustomed to civil or barrack life fail to realise that it is necessary for themselves to carry out their own measures of sanitation.

(*e*) It is often necessary to select camp sites or billets with a view to military necessity, rather than to healthy surroundings.

8. Though losses from disease are more acutely felt during a campaign than in time of peace, yet the waste of men's services in peace time from preventable disease is a very serious matter to the army. Sanitary observance must be enjoined upon the soldier in barracks, with a view to avoiding this wastage, as well as for the purpose of training his mind and making him acquire habits which are essential to his retaining his health in the field.

For as the soldier is taught in peace time to use his weapons with a view to their employment in war, it is no less necessary for him to be instructed and practised in sanitation.

9. HYGIENE is the science of maintaining and increasing the health of mankind. In recent years researches into the conditions necessary for health, into the cause and origin of disease and into the measures for preventing ill-health have made rapid strides ; old vague theories have been discarded; accurate scientific facts have taken their place ; principles and laws of health have been formulated.

SANITATION means the application of the laws, principles and facts of hygiene to the varied conditions under which mankind has to live and work all over the world. The laws of hygiene are the same everywhere, but the practical application of these laws, which is sanitation, largely depends upon circumstances. It is, for example, a law of hygiene, universally applicable, that excreta should be removed at once from the vicinity of human habitations, but sanitation in this respect may mean a water-closet in barracks, a bucket latrine in camp, or a hole in the ground on active service. (*See* also para. 23.)

There occasionally exists a foolish idea that hygiene and sanitation are concerned chiefly, if not solely, with drains and latrines and refuse bins. The removal and disposal of excreta and other refuse is merely a part of sanitation and is known as CONSERVANCY.

10. The aim of hygiene and sanitation is a double one: firstly, to prevent actual disease, and, secondly, to promote and increase health. And these two are by no means the same

thing. A football team, for example, that usually obtains a draw, merely escaping defeat, can scarcely be compared with one which consistently wins its matches.

11. All diseases which attack numbers of people at one time will be found to result from one or other (sometimes both) of the following causes :—

(*a*) Exposure, extremes of heat or cold, bad housing or clothing, unsuitable food, poisonous substances in food or water, defective ventilation, over-exertion at work or recreation, excessive indulgence in alcohol, tobacco, etc., and all these conditions are grouped together under the name of "environment."

(*b*) Invasion of the body by the germs of some communicable (infectious) disease.

Therefore the practice of sanitation in the army seeks to obtain health and the prevention of disease by :—

(*a*) A satisfactory environment;

(*b*) Prevention and control of infectious diseases.

12. Effective measures for the maintenance of health and the prevention of disease can only be devised when the laws of health are understood, when the nature of disease is known, and when the method by which germs invade the body has been traced. Therefore, before proceeding to consider the methods of sanitation, some knowledge must first be acquired of the relation of environment to health and the causes and means of spread of communicable diseases.

CHAPTER II

ENVIRONMENT IN RELATION TO HEALTH

13. The human body is a finely-adjusted and expensive machine whose health and efficiency largely depend upon the conditions under which it lives and works. If it is misused or placed in harmful surroundings, it will work badly or may be damaged, even beyond repair.

Conditions of ill-health or disease, where not due to the invasion of the body by germs, can always be traced to an unfavourable environment.

It is necessary, therefore, to have some knowledge of how the body does its work, and how such things as climate, housing, clothing, air, water, food, duties, recreation, rest (all of which are summed-up in the word "environment") may help or hinder the working of the human machine.

14. All engines require a supply of fuel (coal, oil, petrol) and, in the same way, the body requires its supply of food; but food furnishes not only fuel, it also supplies material to repair and build up the tissues of the body. The quantity and quality of the soldier's diet is, therefore, of great importance.

The general quality of the rations is supervised by the medical service, and the quantities are determined by regulation, the latter varying in different stations at home and abroad, and in barracks, in camp, and on active service.

15. Certain substances called "vitamins" have recently been found to play a very important part in maintaining the body in health, and when they are absent or deficient in a ration, various diseases (*see* paras. 294 to 297) may occur. These substances are present especially in fresh foods—fresh meat, fresh vegetables, fresh fruit—and tend to be absent from tinned foods, jams, margarine, etc.; they are also liable to be destroyed by over-cooking. Dried peas or beans are issued when there is a deficiency of fresh fruit or vegetables; these must be germinated before use (*see* Appendix X).

16. That portion of the food which is used as fuel in the body supplies energy, not only for ordinary work, but also for the work (of the heart, the lungs, the digestive system, etc.) required to keep the body alive. In the same way as the engine of a motor-car burns petrol, so the body burns food in order to do work, and, also like the engine of a car, a large amount of heat is produced when food is burnt up in the body. Further, in the same way as the heat from the engine of a car is got rid of by the radiator, the body gets rid of its waste heat chiefly through the skin.

Therefore, the greater the amount of muscular work done, the greater is the amount of food (*i.e.*, fuel) required; in cold climates more food is required to produce heat and keep the body warm than in hot climates; the amount of heat produced varies with the amount of work being done; and if the body is hampered in any way while doing work, as, for example, by tight clothing or equipment, by pain from sore feet, or by a state of fatigue or ill-health, more heat is produced for a given task or work, than under comfortable working conditions.

During hard physical work, and especially if the weather or climate be warm, the dry skin cannot get rid of all the heat which is being produced. The skin, therefore, begins to perspire and the sweat is evaporated from the surface of the body giving a greater cooling effect.

17. If the body is unable to lose its waste heat, fatigue sets in sooner and actual disease (heat-stroke) may develop.

Examples of conditions under which the body finds it more difficult to get rid of heat are hot climates, heavy or tight clothing preventing the evaporation of sweat, bad ventilation leading to a stagnant atmosphere, very heavy work and, occasionally, lack of drinking water hindering free perspiration (*see* also paras. 177 and 299).

18. While clothing, therefore, must be sufficient to protect the body from weather or accidental injury, it must not interfere unduly with the ventilation of the body surface or the removal of heat from the skin. In general, moderate looseness of fitting is desirable. Military clothing must also be uniform, inconspicuous and hardwearing.

19. Similar considerations apply to equipment, which, from the point of view of health, should bear upon fleshy parts rather than upon bony ridges or prominences, should not compress important internal organs nor interfere with the free action of heart and lungs, and should permit of as free ventilation of the skin as possible.

20. The load (clothing, equipment, pack, arms, ammunition, etc.) carried by a marching soldier exerts a definite influence upon his health. A man can carry a marching load equal to one-third of his own weight without undue exertion, but any marked excess over this amount means that fatigue will set in much more rapidly than otherwise, and the increased work requires a greatly increased supply of food.

21. A supply of water is a constant necessity for the working of the human body; nearly three-fourths of the body are made up of water, one gallon for each stone of body weight.

There is a constant loss of water from the body in the form of sweat, urine, moisture in the breath, etc., and this loss has to be made good. A soldier in marching order may lose, by perspiration alone, nearly a quart of water during a march of eight miles, even in a temperate climate.

22. Man is able to survive and to remain in health under a great variety of climatic conditions, provided that he adapts clothing, diet, work and habits to the climate in which he has to live. Especially is this of importance in warm climates, where men are apt to continue modes of lives formed in a temperate climate and unsuitable for the tropics. If care be taken in regard to these matters (*see* paras. 176 to 182), climatic conditions by themselves are a health factor of no great importance, and cold climates are usually very healthy.

A few diseases are truly climatic in origin, such as heat-stroke or sunstroke (*see* para. 298) and tropical neurasthenia in hot climates, frost-bite, trench foot (*see* para. 301), and snow blindness in cold climates.

23. The subject of housing affords an excellent example of the distinction between *hygiene* and *sanitation*. The laws of *hygiene* state that dwellings must afford adequate protection from the weather and from extremes of temperature, that access of sunlight and fresh air must be sufficient, and that the interior air must be kept pure by ventilation and the proper disposal of waste matters. On the other hand, the methods by which these essentials are obtained (i.e. *sanitation*) vary greatly, according to whether troops are in barracks, billets, camps, bivouacs, ships, trains, or in front line trenches.

24. A sufficient supply of pure fresh air is essential to health. With defective ventilation, the air in an occupied room soon becomes contaminated with gases, moisture and impurities breathed out from the lungs or given off from the bodies of the occupants. When such impure air is breathed habitually, conditions of ill-health are certain to follow.

25. Warm stagnant air, full of moisture, as is found in badly ventilated rooms, hinders also the loss of waste heat (*see* para. 16) from the body, causing discomfort or, if associated with a high air temperature, even heat-stroke. The comfort of a fresh cold atmosphere is largely due to the effective removal of surplus body heat and to the gentle movement of the air stimulating the sense of touch in the skin.

26. The prompt removal of all kinds of waste material and refuse from the place where one lives, eats and sleeps is an obvious necessity, yet neglect in this respect is one of the commonest sanitary faults.

Of the items included under refuse, the excreta of the body are of outstanding sanitary importance ; not only do the germs of many important diseases leave the body in fæces and urine, but the former are a favourite breeding ground for flies. Horse manure, also, furnishes ideal conditions for fly-breeding.

Accumulation of other refuse, though perhaps less dangerous to health, indicates neglect of general cleanliness and sanitation.

27. The essential points in the disposal of refuse (especially excreta) are prompt removal from the vicinity of human habitations and disposal in such a way that fly-breeding is prevented and no danger exists of the contamination of food or drinking water.

28. The importance of the skin as a protective covering for the body and as a cooling surface has been considered, but the skin cannot act properly if it is not kept clean. If

sweat is constantly allowed to remain and dry on the skin or to soak into the clothing, the sweat decomposes, offensive body odours develop, and the skin becomes unhealthy and inflamed.

29. Personal cleanliness, regular bathing, the removal of all dirt, therefore, is an important factor in health. It is not sufficient merely to keep the face and hands clean, the rest of the body, even though hidden by clothes, requires regular attention, especially in those parts the armpits, the fork, the feet and toes, where skin surfaces are in contact.

30. Nor must the practice of cleanliness be limited to the exterior of the body. The mouth must be kept clean by strict attention to the teeth, and the intestines must be kept free from decomposing waste material by a regular daily movement of the bowels. It is now known that rheumatic affections and other diseases frequently result from the presence in the mouth of decayed teeth or from conditions of habitual constipation.

31. In order that man may do his work well, periods of rest are necessary; sufficient hours of sleep are necessary for everyone, especially for young growing recruits.

The average adult man should have not less than eight hours of sleep and the most refreshing sleep is that obtained during the first hour or two. Heavy meals should not be taken shortly before going to bed.

32. There is much truth in the saying that "all work and no play make Jack a dull boy" and recreation and amusement are essential items in a healthy life. The provision of facilities for outdoor and indoor recreation under regimental arrangements and in barracks has a further important bearing on the health of the soldier, as there is then less temptation to seek recreation and amusement in doubtful surroundings outside. There is no doubt that increased facilities for recreation within the army have been one of the chief factors in the reduction of venereal diseases (*see* para. 308).

33. The subjects discussed in this chapter make it evident that a healthy environment means, firstly, a knowledge of how the human machine works, and secondly, the provision of surroundings, food, water, air, clothing, work, rest, recreation of such a nature that they assist, instead of hindering, the normal working of the human body.

Environment must be studied not only in regard to possible defects which may produce ill-health or disease, but even more in regard to the help which it can give in maintaining and increasing physical and mental fitness.

CHAPTER III

CAUSES AND MEANS OF SPREAD OF COMMUNICABLE DISEASES

34. All communicable (infectious) diseases are caused by germs which, after invading the body, develop and multiply in susceptible persons. In some cases they may not develop at once, but may lie dormant in the body until, by lowered vitality or power of resistance, conditions become favourable to their development.

35. The germs which produce disease form an extremely small minority among enormous numbers of beneficent or harmless germs that exist in nature.

Germs are also called microbes or micro-organisms and the majority of disease germs belong to the lower forms of the vegetable kingdom, but many important diseases are also caused by lowly forms of the animal kingdom.

Animal germs are represented chiefly by protozoa (amœbæ, spirochætes, etc.); germs of the vegetable kingdom (bacteria) are generally named according to their shape, as bacilli, cocci, vibrios, etc. (Fig. 2, page 20).

36. Germs are exceedingly minute; eight thousand bacilli of enteric fever, for example, placed end to end would have a length of only one inch.

They multiply very rapidly under suitable conditions; a bacillus may split into two new bacilli in about half-an-hour and, if each new bacillus continued to propagate in the same way, by the end of ten hours over one million will have developed from the original germ. In the case of disease germs the temperature and other conditions of the human body are favourable to such development; but many germs can live for a certain time outside the body in water, food, soil, clothing or refuse, and some form spores. These spores are similar to the seeds of plants and are able to survive under conditions which would be fatal to the ordinary germ. Germs can be grown, and may be seen in any bacteriological laboratory.

37. Three factors are necessary before any case of communicable disease can occur. There must be, firstly, a *source* (usually human) from which the germs come, secondly, a *route* by which the germs travel or are carried from the source to, thirdly, a *destination* in the body of a susceptible person (Fig. 3, page 18). It is by studying the way in which germs leave the source (the human or animal body), travel

from the sick to the healthy, and invade the body of a fresh victim, that we can form plans for preventing the spread of the diseases which they cause.

38. In the case of human infections the source of the germs is generally man, the most obvious example being a patient

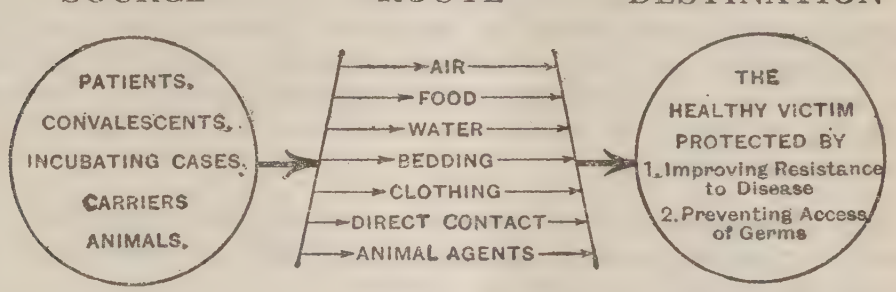


FIG. 3.—The three factors concerned in the spread of infectious disease.

suffering from the disease. Therefore, such patients must be isolated, and are usually treated in a special hospital to ensure the complete separation of the sick from the healthy ; and it is important that every case of communicable disease amongst troops should be promptly recognised so that precautions may be taken at once to prevent the spread of germs from the sick man.

39. It is very important to realise that the human source of disease germs may not be obviously ill. In the case of several infectious diseases the patient may be spreading germs widely long before he feels sufficiently ill to report sick. Further, many apparently healthy men carry the germs of disease in nose, or throat, or bowel, or elsewhere, and occasionally or constantly are passing these germs out of the body. Many men who have suffered from an attack of typhoid fever or dysentery continue to pass the germs from the bowel for a considerable period—sometimes for years—after apparent recovery. Such "carriers" have caused epidemics of typhoid fever by the handling of food or drinking water and, therefore, it is a rule that no person who has suffered from typhoid fever, dysentery, or cholera is to be employed as a cook or upon any duty that entails the handling of food or the purification of drinking water.

It is thus seen that human sources of disease germs may exist even in the absence of any obvious signs of illness.

40. Animal sources of disease germs are less important than human sources, but the germs of some very serious diseases come from animals. In plague, for example, the rat is the chief source of the germs; infection in undulant

fever comes from goats, the germs being passed in the milk, and cases of glanders in horses may originate the disease in man.

41. Disease germs pass out from the human or animal sources in the fæces, urine, sweat, milk, expectoration, vomit, etc., while the bodies of men or animals that have died of a communicable disease are full of germs and, naturally, dangerous to handle.

42. When the germs of disease leave their human or animal source they may pass immediately to a fresh victim through the actual contact of healthy with sick, or the intervening time (or space) may be extremely brief in the absence of actual contact; both cases are described as "direct contact."

Instances are seen in the venereal diseases where germs may pass from a diseased woman to a healthy man during physical contact; in influenza and colds where coughing or sneezing projects germs into air which is immediately breathed in by the patient's neighbours; or where persons suffering from communicable disease, before removal to hospital, have been living, eating and sleeping with other men in the same barrack-room or tent.

It is now recognised that "direct contact" is a much more important route than any other for the passage of germs of disease from sick to healthy persons.

43. Germs of disease which have left the body may continue to live in such things as food, water, air, bedding, clothing, utensils, soil, dust and dirt, and may survive long enough to be conveyed by these means to healthy persons and thus infect them. Excreta, for example, left uncovered may become dried and the dust with the contained germs may fall into drinking water or on to food; where latrines are placed too near a source of water supply the germs in the fæces or urine may soak through the soil and be found in the water; and food or water will receive germs of disease if cooks or other persons handling these articles of diet are suffering from an infectious disease or are "carriers." If cups and forks and spoons are not properly washed in boiling water after use, germs in the saliva may continue to live until they pass to the next user. Where a man indulges in the filthy habit of spitting, the expectorated matter may dry and the germs be blown about in the air until they are breathed in by some other person. Articles which have been used by the sick, such as clothing, equipment, bedding, pipes, etc., are obviously dangerous until any germs which they contain have been killed by disinfection.

With so many possible routes by which germs may pass from the sick to the healthy it is evident that a high standard of sanitation must always be maintained.

44. Another route by which germs of disease may travel from their source to a new human destination is by the agency of animals. Rats, for example, living in sewers and refuse heaps can easily carry filth and germs from these places to human food, but, of all animals, insects are of outstanding importance in conveying germs from man to man. In fact there are many diseases which cannot spread from person to person except through the agency of some insect.

45. Mosquitoes, for example, play an essential part in the spread of certain diseases, especially malaria and yellow fever. The mosquito, feeding on a patient suffering from one of those diseases, sucks in the germs along with the feed of blood, harbours them in its own body and, after a period of development, injects them into the blood of any healthy person whom it may subsequently bite.

Mosquitoes, therefore, are agents for carrying germs of certain diseases from infected to healthy persons, and their destruction is an important preventive measure in these diseases (*see* paras. 205 to 211).

46. In the case of intestinal diseases, such as typhoid fever, dysentery, cholera, and diarrhœa, the germs are frequently spread by flies. It has been noted, especially in warm climates, that increased numbers of flies are commonly followed by outbreaks of these diseases. (Figs. 4 and 5.)

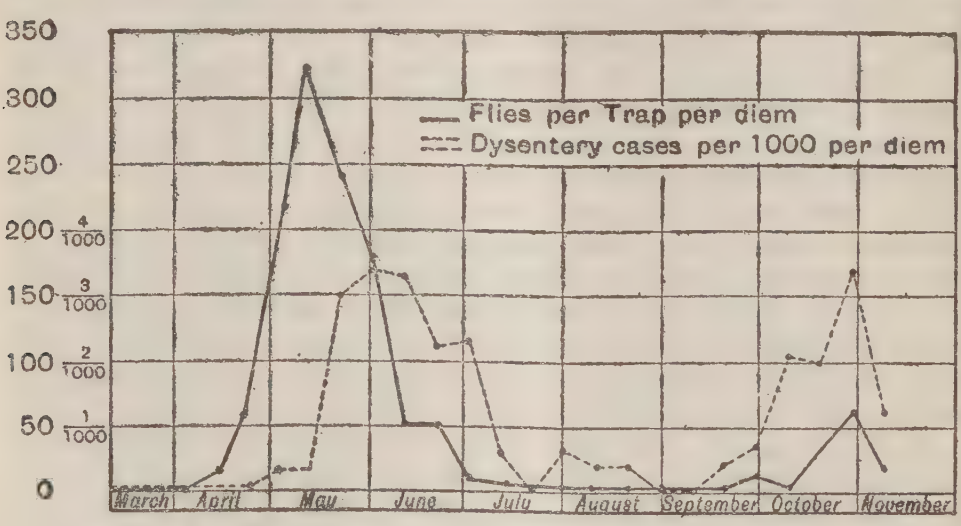


FIG. 5.—Relationship of fly prevalence to dysentery.

These insects breed in excreta and other refuse and are numerous wherever such material is deposited; they also

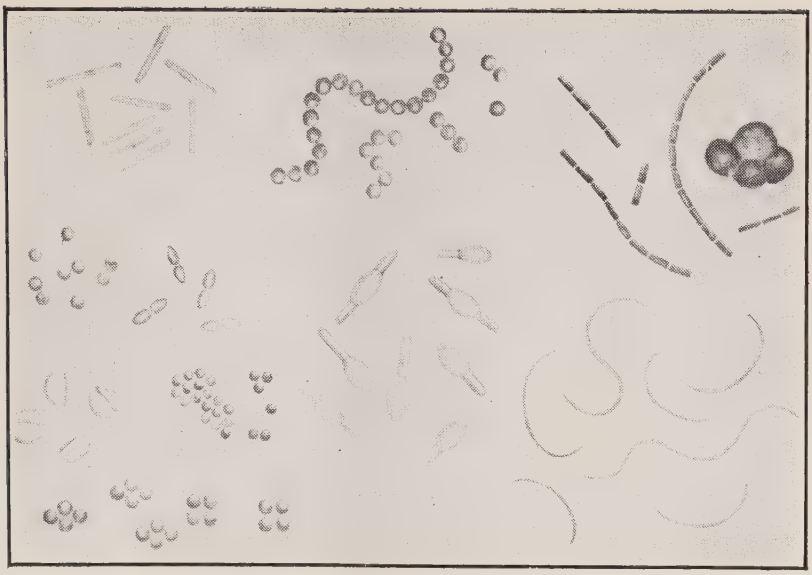


FIG. 2.—Examples of disease germs (bacteria).

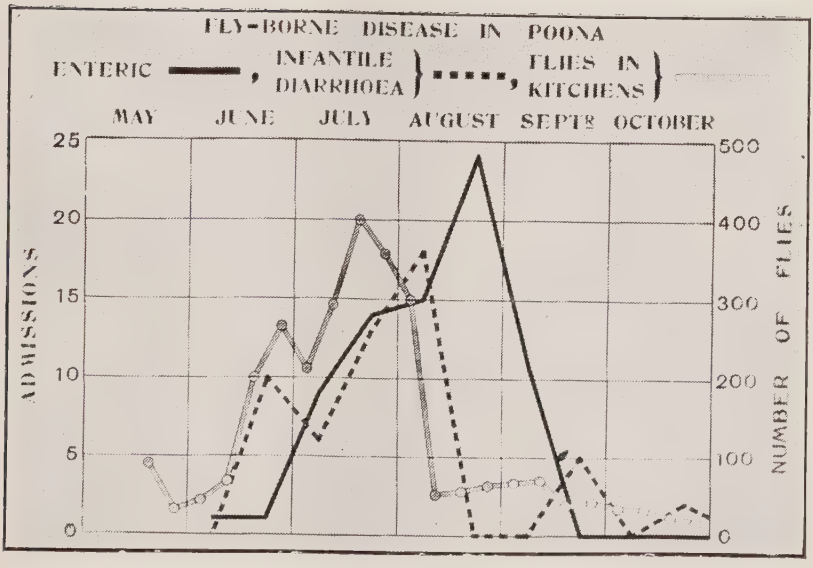


FIG. 4.—Relationship of fly prevalence to typhoid fever.

swarm in cook-houses, larders, and dining rooms in order to feed on such things as milk, sugar, jam, bread, etc. It is, therefore, easy to understand how these insects transfer germs of disease from latrines and refuse heaps to human food.

The destruction of flies (*see* paras. 185 to 202) and the protection of articles of food from fly contamination (*see* paras. 203 and 204) are of great importance in preventing intestinal diseases.

47. Lice have also been proved to play a necessary part in the spread of certain diseases. The germs, for example, of typhus fever, relapsing fever, and trench fever, are now known to be transferred from sick to healthy persons by lice; personal cleanliness thus becomes a health factor of even greater importance than was formerly the case.

48. Germs of disease which have come from a source of infection and have been carried to a healthy person by any of the means already described may enter the body by the mouth, either in water, or food, or dust that is inhaled or swallowed. In some diseases they enter through the broken skin, and in others they are carried and inserted into the blood by insects, such as mosquitoes, biting flies, ticks or fleas, which have previously fed on diseased animals or men.

When the body is in robust health it has the power of resisting the invasion of the germs, and there are certain constituents of the body, notably in the blood, which render them harmless; but when the system is reduced by privation, exposure, fatigue or mental overwork, this power of resistance is much diminished, and the disease germs are then able to overcome the normal resistance to their development in the body, and so produce sickness.

The healthy man, therefore, may be protected in two ways, either by preventing the entrance of germs into the body, or by increasing the man's resistance so that, even though germs of disease gain entrance, they are rapidly destroyed or rendered harmless in the body.

49. As examples of the first method of protection, *i.e.*, preventing the entrance into the body of germs of disease, may be mentioned the use of nets and special clothing (*see* paras. 212 to 215) against mosquitoes, protection of food against flies by larders, meat safes and wire gauze covers, the desirable practice of washing the hands before meals, and the use of a rubber sheath over the penis as a measure against venereal disease.

50. The second method of protection, *i.e.*, increasing the power of the body to destroy any germs which may have

entered, is represented by all measures which tend to improve general health, and the avoidance of anything that lowers the power of resistance to disease, or that renders the individual more susceptible to its influence, such as undue exposure to great heat or cold, wet, sudden changes in temperature, recent arrival in a hot climate, insufficient or improper food and clothing, excessive fatigue, mental depression, overcrowding in barracks, insanitary surroundings, careless and dirty habits, dissipation, and, in the case of some diseases, notably enteric fever, youth. It may be said generally that, partly owing to carelessness and inexperience, and partly to the fact that they have not acquired immunity by a previous attack, young soldiers are the commonest victims in the army of all communicable disease.

51. It is possible, by what is known as preventive inoculation, to increase enormously the resisting power of the body to certain diseases.

Already great success has been obtained by this method in regard to small-pox, typhoid fever, cholera and plague. All soldiers, unless they have suffered from smallpox, must submit to vaccination or re-vaccination on enlistment, and should be inoculated against the typhoid group of fevers before proceeding on service overseas, and against cholera and plague whenever an outbreak occurs or is threatened.

It must be remembered, however, that many communicable diseases are not yet preventable by inoculation, that, even in such a disease as typhoid, inoculation may fail to protect where there is bad sanitation, and that preventive inoculation never means that other sanitary measures may be neglected without danger.

52. In view of what has been said in this chapter, it is now possible to summarise the measures of prevention against communicable diseases, as follows:—

(*a*) **Measures applicable to the SOURCE:—**

Isolation of patients and disinfection of their excreta; control of contacts; detection of mild cases; prevention of food handling by possible "carriers"; destruction of animal sources.

(*b*) **Measures applicable to the ROUTE:—**

Protection and purification of drinking water; cleanliness and protection of food; adequate spacing and ventilation; disinfection of bedding, clothing, etc.; control and destruction of animal agents; prevention of contact between sick and healthy.

(*c*) **Measures applicable to the DESTINATION:—**

Increased general resistance by satisfactory conditions of environment; increased resistance to special diseases by preventive inoculation; protection of the healthy man from the access of germs of disease.

CHAPTER IV

GENERAL SANITARY MEASURES

FOOD.

53. The soldier's daily food must be varied in the manner of its preparation. A monotonous diet is unappetising and trying to the digestion. In barracks it is easy to vary the diet, and much more attention than formerly is now given to the matter. Even in the field variety may be obtained. Every man should be taught to cook in his mess-tin, and cooks should make the best use of preserved rations and also of the uncooked flour, dried fruit and rice, which are occasionally issued.

54. Attention must also be paid to the general messing arrangements. Food which is served half-cold or in a slovenly and unappetising manner loses much of its value and discourages good digestion.

55. Every care must be taken to prevent food becoming contaminated by flies, dust, dirty utensils, etc. Cooks and all other persons handling food must pay special attention to the cleanliness of person and clothing. They must on no account continue at their duties if suffering from any illness, especially even the slightest attack of diarrhœa, and no person with a history of an attack of typhoid fever, dysentery, etc., is allowed to be employed on such duties (*see* para. 39).

56. Food must not be stored in living or sleeping rooms, near latrines, nor in any dirty place or where exposed to flies (*see* paras. 203 and 204). In barracks ventilated fly-proof larders and foodstores are provided, and in camp or on service these are equally necessary and can be improvised from wire gauze, muslin, mosquito netting, etc. Muslin and mosquito netting are never so satisfactory as wire gauze safes and covers, as they readily get torn and dirty, and are difficult to clean without shrinkage. If used, the material should be arranged over a framework of wood or wire and never laid directly on to the food. It should be easily removable from the frame for cleaning purposes.

Cooking destroys many germs of disease in foods, therefore cleanliness and protection from contamination are even more important in the case of cooked foods or foods eaten raw. The practice of cooking food, especially made-up dishes, overnight for consumption next day should be avoided whenever possible.

57. Cook-houses must be kept scrupulously clean. Tables, chopping-blocks, cutting-up boards, pastry-boards, etc., must be scrubbed after use and all utensils carefully washed, dried, and put away so that the interiors are open to the air. Pots and pans must never be scoured with earth or sand, which may contain germs of disease. Powdered ashes from the kitchen fire should be used for this purpose.

58. No food should be used from tins that are "blown," rusty, or badly dented, because such conditions indicate either that decomposition has taken place in the food inside the tin, or else that the tin will probably cease to be airtight, and the food thus become exposed to outside contamination.

59. Food purchased from hawkers is frequently dangerous, especially in stations abroad. No itinerant vendors of food should be allowed in camps or barracks; if permitted in exceptional cases, they must be licensed and their person, premises, and viands subject to medical inspection.

In the field and, if necessary, in foreign stations markets should be formed for the sale of fresh provisions, and placed under supervision.

WATER.

60. Absolutely pure water is not to be found in nature. Even as it falls through the air in the form of rain, it may be polluted and, after it has reached the earth, it finds numerous sources of pollution from contaminated soil, surface refuse, drainage, etc.

Therefore it is essential that ALL water should be regarded as dangerous, unless it has been approved by a medical officer or has been satisfactorily purified by one of the methods to be described.

Purity of water supply is one of the most important measures for the prevention of disease, as impure water is seldom free from germs of disease (*see* para. 43) and in some countries conveys infection of parasitic worms (*see* para. 291).

61. A daily average of 1 gallon for each man is sufficient for drinking and cooking purposes, except in the tropics where 2 or 3 gallons should be supplied. A horse, bullock, or mule drinks about $1\frac{1}{2}$ gallons at a time, and requires about 6 gallons a day in a temperate climate. In standing camps, an average allowance of 5 gallons should be given for a man, and 10 gallons

for a horse. The quantity required by men and animals varies somewhat according to meteorological conditions and the work that individuals are called upon to perform (*see* para. 21).

62. The source of water supply is governed by many circumstances.

Water is practically always procured locally, but occasionally it has had to be carried for troops from a distance or by pipe lines laid by the engineers.

It may be drawn from wells, springs, streams, rivers, lakes, ponds, or rainwater tanks.

In all these cases it may be polluted at its source, during its carriage, during its temporary storage, and during its distribution in cooking pots, men's water-bottles, jugs, &c.

During its whole course, from the source to the men's mouths, it requires watching and safeguarding.

The danger of impure water lies in the fact that it may contain germs of disease, and methods of purification are intended to eliminate or destroy them.

63. The sources of water may be considered to be, as a rule, in the following order of purity :—

Artesian wells and deep borings.
Deep wells.
Springs.
Rainwater.
Large lakes (centre of).
Rivers (mid-stream).
Small streams.
Large lakes, near bank.
Shallow wells.
Rivers, near banks.
Ponds.

64. Artesian wells, deep borings and deep wells usually give a safe water, provided that they are properly constructed and protected (*see* para. 72).

65. Springs are also usually good, if no dwellings with drains and cesspits are near and if the spring is properly protected (*see* para. 73).

66. Rain water, if freshly caught in *clean* vessels, gives a safe supply in emergency.

67. Large lakes supply good water if it be taken at a considerable distance (near the centre of the lake) from the banks, especially if the lake be clear with a rocky or firm bottom.

If taken near the bank, and certainly if there are dwellings in the vicinity, lake water is unsafe.

68. The purity of water from rivers and streams varies very much. Small streams are safest near their source; dwellings and grazing grounds on or near their banks and draining into them are dangerous sources of contamination.

In all countries, towns and villages are commonly situated on the banks of rivers, and in such cases the water for miles below is certain to be contaminated.

Where the country is very sparsely populated, the stream very swift, as in mountain districts, and a great volume of water, the contamination may not be so great.

69. Shallow wells, receiving water from the surface and upper layers of the ground, are always dangerously polluted. Such wells exist in large numbers in most villages and in many towns, and water from these must never be consumed until it has been purified.

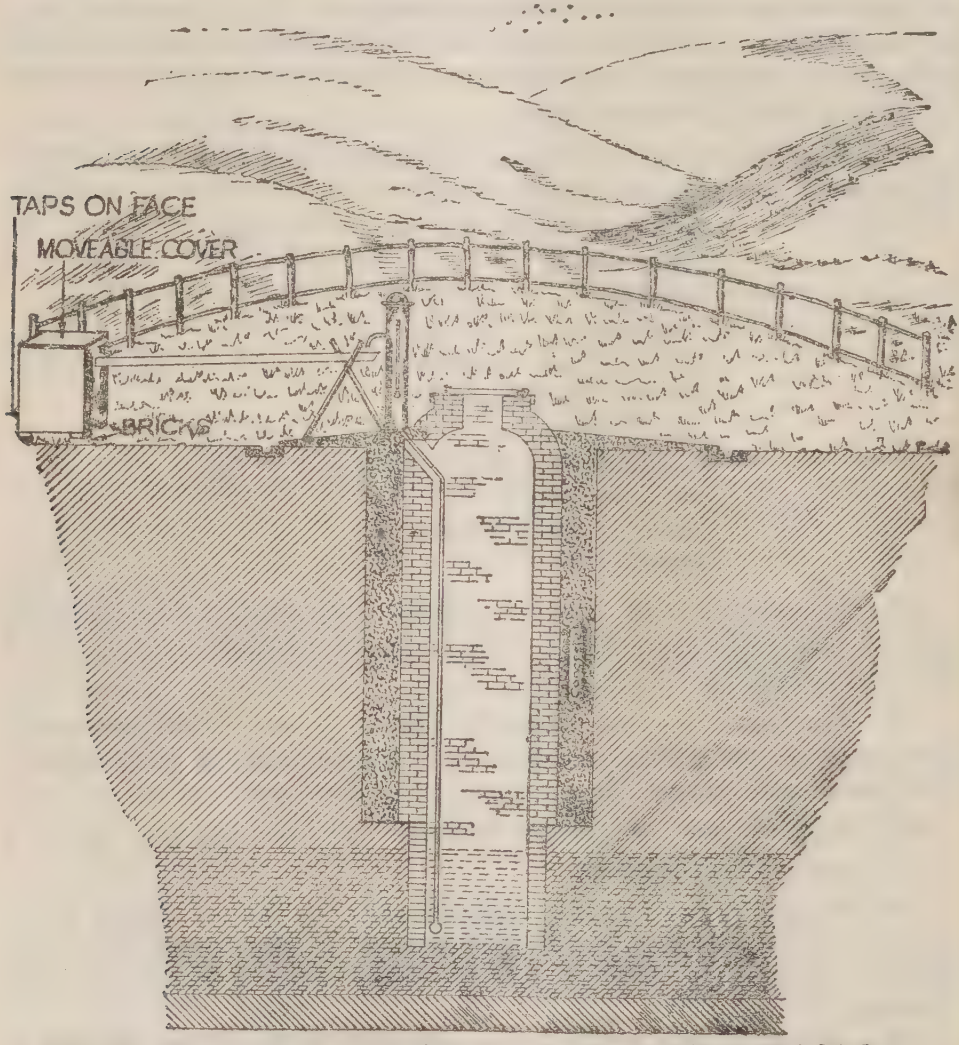


FIG. 6.—Properly protected well. Section of Well 20′ 0″ deep, 4′ 0″ wide.

All such wells must be carefully protected (*see* para. 72) from pollution.

70. Water from ponds or small surface collections is *always* unsafe and must invariably be purified.

On active service the practice of drinking water which has accumulated in shell-holes must be prohibited. Such holes may, only a short time previously, have been used as latrines, and intestinal diseases—notably dysentery—have frequently been spread in this way.

71. In the selection of a source of water supply, the appearance of the water gives no guarantee of safety; the most dangerous waters may look clear and sparkling.

From whatever source water is drawn, it must be protected from contamination during the whole journey from source to consumer.

72. Wells should be steened, fitted with a cover and coping, and the water obtained by a pump in preference to a bucket (Fig. 6); the ground surface round the mouth of the well should be fenced off.

73. Springs frequently issue from the side of a hill, and the flow of water is not very rapid. The water usually comes from a number of crevices, and the ground for some yards round should be fenced off, and a basin cut in the face of the hill to collect the water, which may then be led into vessels by means of an extemporised spout.

A protecting trench should be cut on the slope above the spring to prevent contamination by surface washings and in permanent supplies the spring and basin may be enclosed in brickwork (Fig. 7).

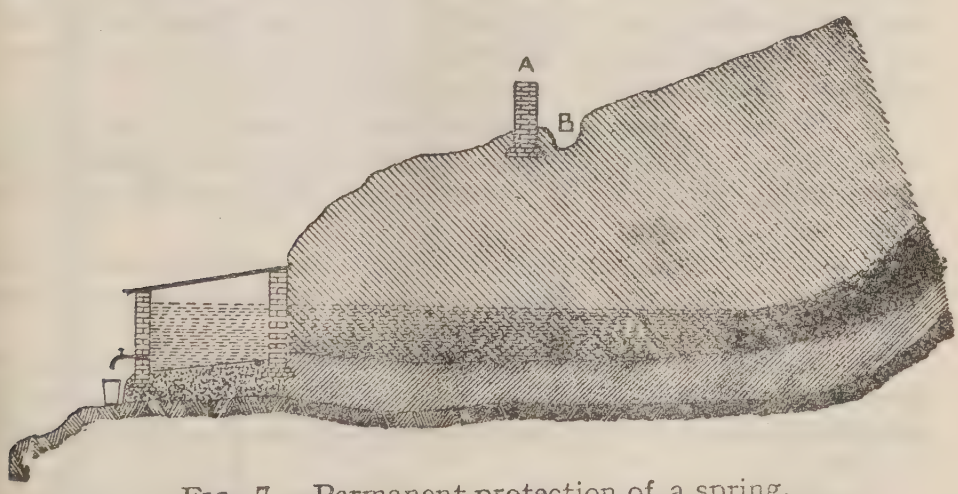


FIG. 7.—Permanent protection of a spring.

A, B } To intercept surface-water. A=WALL. B=DRAIN

74. The water from small streams must be collected as near their source as possible. If the valley forming the collecting area is a small one, the part above the water supply should be put out of bounds, and animals kept from grazing on it. In all cases the stream should be examined as high up as possible with the object of discovering any possible sources of pollution and any carcases or filth should be cleared from the collecting area or stream.

If the stream is very small, a dam should be made, and the water led over a weir into vessels, or pumped out from above the dam. When dippers are used, there is much danger of contamination to the water. The dipper is usually left on the muddy soil by the side of the dam, and may thus pollute the water with dirt from men and animals.

If time does not admit of such arrangements being made water must be taken from the middle, where it is cleanest, and not from the edges of the stream.

Mid-stream is the safest position from which to collect river water, but it may be taken as a rule that all river and stream water must be sterilised before being used for drinking.

Places for obtaining drinking water, watering places for animals, and ablution places are selected in the above order from up-stream downwards and marked by white, blue, and red flags respectively (Fig. 8).

These places must be arranged with a view to preventing water supplies lower down stream, such as the water supplies of villages and towns, or other camps, from being contaminated by the troops up stream. It is always safest to provide for the watering of horses and for ablution by means of troughs, erected at a convenient distance from the banks, whenever this is possible, and always below the intake for drinking water. In addition the place for obtaining drinking water should have a stoned approach and the water should be drawn by a pump and hose rather than by buckets or dippers.

75. Water is generally carried from its source to the camp in water carts, or in iron tanks on wheels, but other vessels such as petrol tins, canvas tanks, barrels, earthen chatties, and skins of animals are used.

In all cases the greatest care must be taken to keep these receptacles clean, and they should frequently be inspected and sterilised.

Men must not be allowed to drink direct from the taps of the carts, or from the rim or spouts of other receptacles for carrying or distributing water; and all open vessels must have covers.

Protection against dust and other contamination is necessary, and the storage tanks must be thoroughly cleaned at frequent intervals.

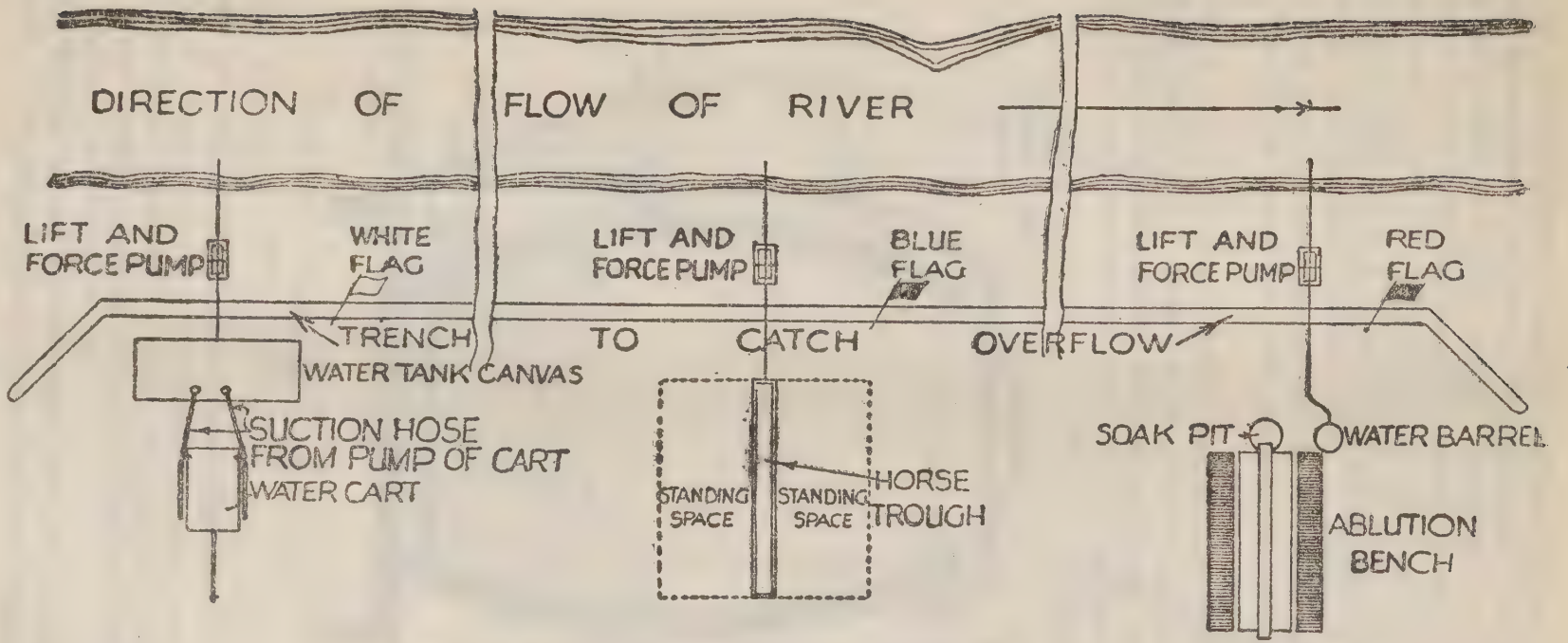


FIG. 8.—Protection of water supply from a stream.

76. The standard method of water purification in the army consists of (*a*) clarification by alum, followed by (*b*) sterilization by chlorine. Both parts of the process are essential and the existence of an apparently clear water does not render clarification unnecessary.

77. Alum is supplied in the form of "Clarifying Powder" (aluminium sulphate, 2 parts, sodium carbonate, anhydrous, 1 part); when added to water this forms a whitish precipitate which entangles particles of dirt and many of the contained germs.

This whitish precipitate (along with the dirt) is then removed by allowing the water to stand. The precipitate sinks to the bottom and the clarified water may be drawn off from the top. This process may be carried out in a tank, barrel, or other receptacle (Fig. 9).

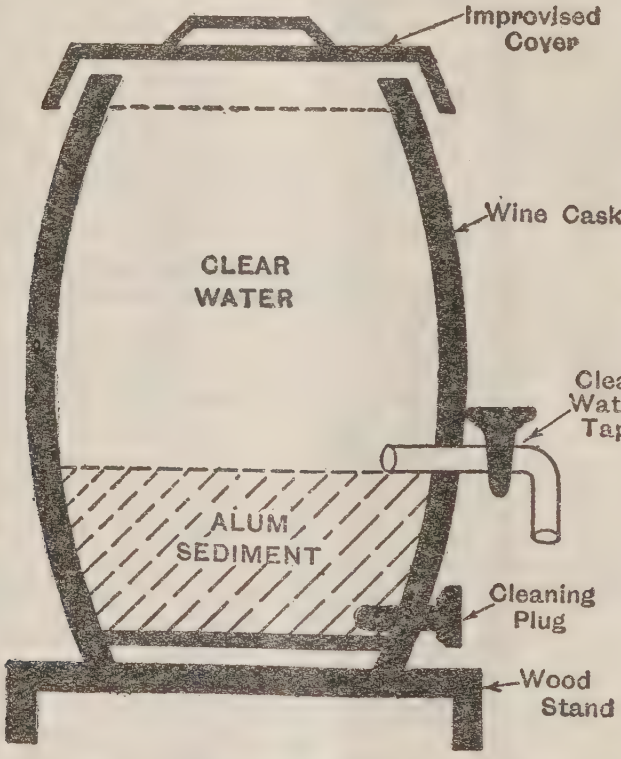


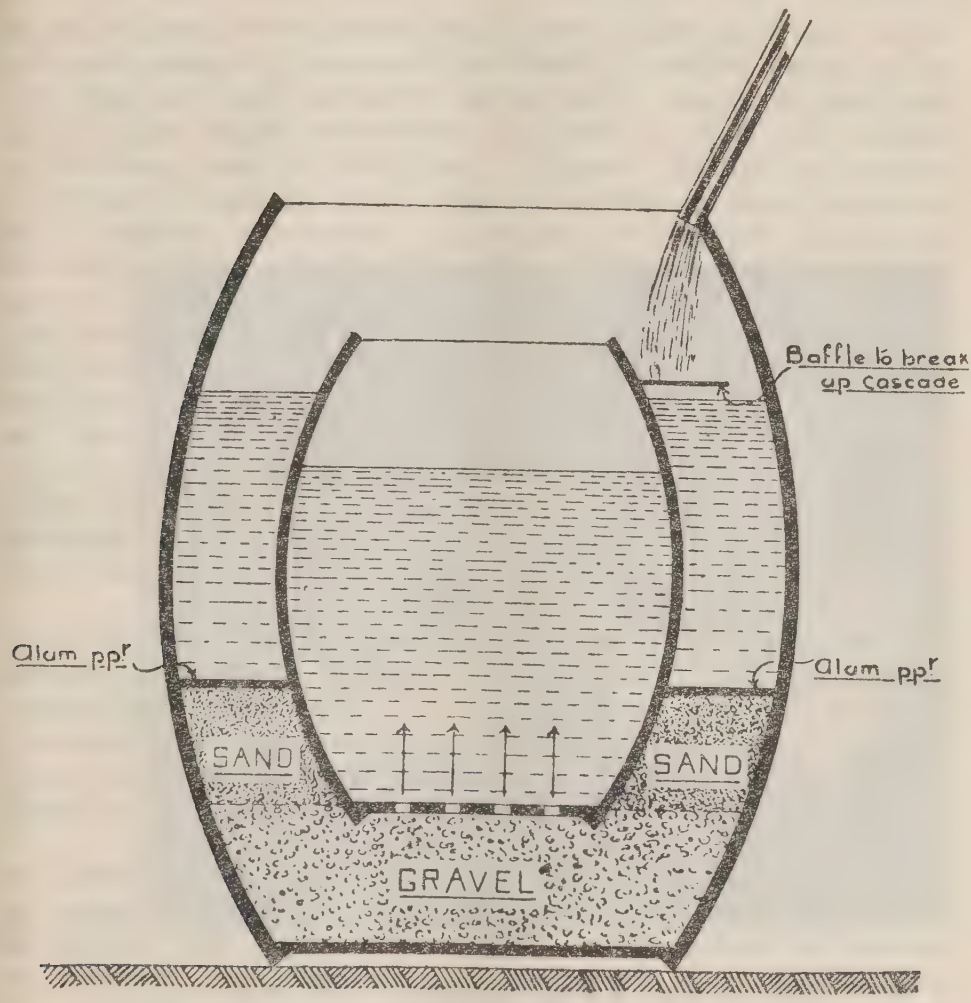
FIG. 9.—Barrel for alum clarification by sedimentation.

Alternatively, clarifying powder may be added to the water which is then passed through a layer of sand in a container (Fig. 10), or through a cloth. The alum and dirt remain behind and the clarified water passes through into another vessel.

The amount of alum required varies for different waters but is usually about five grains to each gallon.

78. The clarified water is now treated with chlorine in the form of chlorine gas or bleaching powder, the amount required being determined by the use of a "case, water-testing, sterilization" (Fig. 11, page 32). Instructions for the use of this case are given in Appendix I.

The bleaching powder is supplied in the form of "Water sterilizing powder (chlorine)," which consists of an intimate



SECTION

FIG. 10.—Barrel for clarification by alum and filtration through sand.

mixture by weight of 80 per cent. commercial bleaching powder and 20 per cent, of freshly ignited quicklime (calcium oxide).

This mixture must contain by weight not less than 25 per cent. of available chlorine and not less than 7½ per cent. of uncombined quicklime (as CaO).

Chlorination may be performed in a tank, barrel, or any container of suitable size.

79. This method of alum and chlorine purification is used in the regimental water-cart (Fig. 12, page 33), where the water, after clarification by clarifying powder and passage through canvas strainers undergoes chlorine treatment, using water sterilizing powder (chlorine), in the tank. Two water-carts are provided for an infantry battalion and will fill the water bottles of about 900 men.

80. The tank holds about 110 gallons of water, and is divided up by cross baffles to break up the water pressure when the cart is on the move. Two metal cylinders (Fig. 13, page 33), fixed at the front of the cart, carry wire cages round which canvas is tightly wound. The cylinder head contains a fine wire gauze receptacle through which the water must pass; in this are placed four scoopfuls of clarifying powder. The water passing through the cylinder head takes up the chemical and deposits a gelatinous layer on the surface of the canvas filter. Until this layer is formed, filtration is imperfect and the water must be allowed to run to waste. It is most important to see that the canvas is tightly and accurately wrapped round the cage. The water must be pumped through the cylinder at about 15 strokes a minute. With both pumps working, it takes about half-an-hour to fill the water cart. When there is much suspended matter the canvas requires frequent cleansing, which may be done by washing the cloth and boiling it in the receptacle provided.

After clarification the water is tested, the Horrocks' test outfit being used to ascertain the quantity of bleaching powder required for the destruction of all dangerous organisms. The requisite quantity of water sterilizing powder (chlorine) is then mixed with water in a cup or other receptacle and added to the water in the tank, being thoroughly stirred with a clean stick.

Whenever possible the treated water should be allowed to stand overnight, but if necessary it may be used after an interval of half-an-hour. Water which has been treated in this way may taste slightly of the chemical used; this may be disregarded as the treatment is quite free from danger.

The tank should be kept absolutely clean. A long-handled brush is provided for cleaning purposes, and the tank should at regular intervals be scrubbed out with a solution of bleaching powder twice the strength of that required to ensure sterilisation.

Bleaching powder must be stored in jars or air-tight metal receptacles smeared with vaseline.

81. It is obvious that the use of clarifying powder and water sterilizing powder (chlorine) is not confined to the water cart. Any suitable receptacle may be used for the

FIG. 11.—"Case water testing sterilization."

FIG. 12.—Regimental Water Cart.

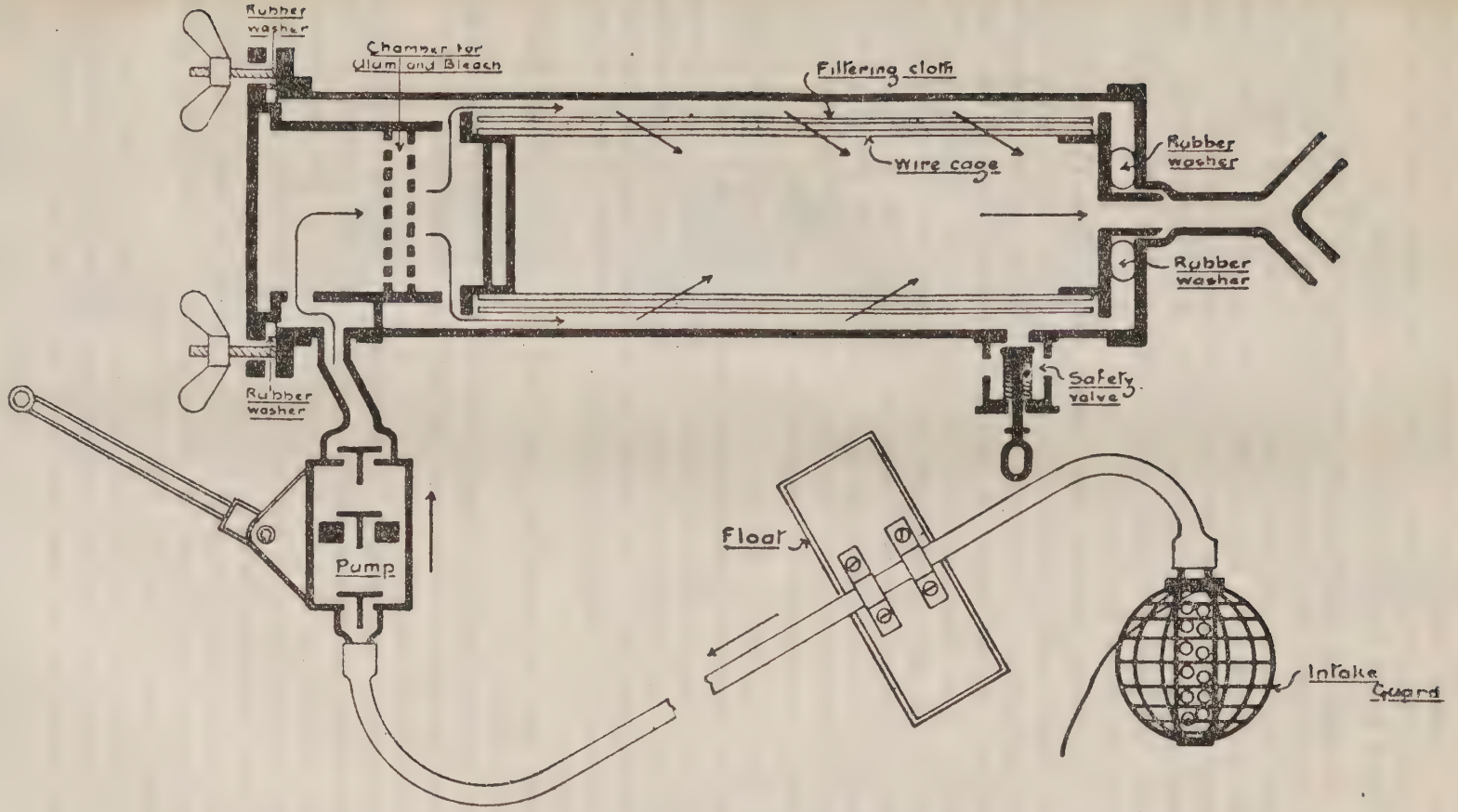


FIG. 13.—Clarifying cylinder from Water Cart. (Semi-Diagrammatic).

process or improvised installations (Fig. 14) may be established. Water carts are filled from tank E in Fig. 14 by their own pumps and hose; for filling other receptacles an additional hand pump and hose are required.

82. A method suitable for sterilizing small quantities of water by means of chlorine is the following. If the water has been found to require, say, two measures of sterilizing powder (chlorine) to 110 gallons (*see* Appendix I), then two measures of sterilizing powder (chlorine) are added to the contents of one water-bottle. From this water-bottle, one measure of this concentrated solution is added to each bottle of water to be treated.

83. Sterilizing tablets are issued for use in the field by mobile units and others who are out of touch with any recognised source of supply. Two of these tablets must be placed in a quart water-bottle and allowed to act for half an hour. The chemical used is acid sodium sulphate, and in view of its acid properties water so treated should not be allowed to remain in water-bottles longer than is absolutely necessary. These tablets should not be used in water-bottles made of German silver, Britannia or white metal, but may be used in aluminium or enamelled iron bottles.

84. The boiling of water is a sure way of rendering it safe, though it has the disadvantage that it does not get rid of sand, clay, and other suspended matter, which may cause injury to the intestinal tract. With proper organization and sufficient fuel it is possible, in emergency, to produce by this means a safe supply of water sufficient for drinking purposes.

Water may be boiled in camp kettles, each of which holds twelve quarts.

The kettles must be kept covered while the water cools, or, until its distribution into the bottles, which must be filled direct from the kettle.

The use of tea should be encouraged, as its preparation destroys any dangerous germs which may be present in the water. When on the march a good plan is to fill the water-bottles overnight with boiling tea, thus providing a safe and palatable beverage for the following day.

Men should be encouraged to boil water in their mess-tins, in order to train them in this method of purifying their drinking water when on detached duty.

85. Water may be purified by distillation, and this method may have to be adopted where water contains so much dissolved material or is so brackish that it cannot be drunk.

86. Apparatus has been manufactured for sterilizing water on the principle of what is known as "heat exchange," by

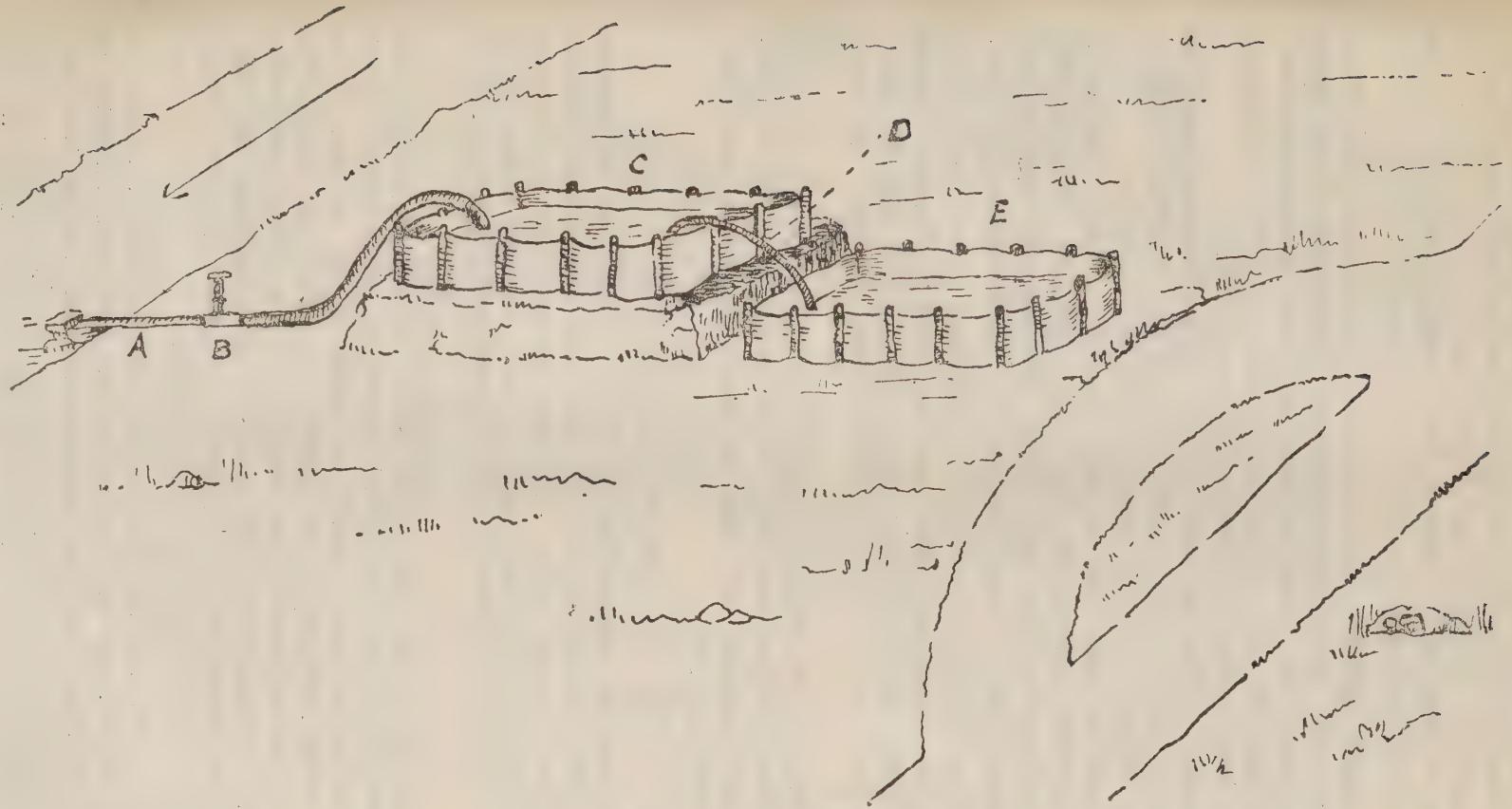


FIG. 14.—Improvised Water Point.

Waterproof tanks of 2,300 gallons, actual capacity of each 1,500 gallons.

A.—Crude water suction pipe.
B.—Hand pump.
C.—Clarifying tank.
D.—Syphon pipe.
E.—Chlorinating tank.

NOTE.—Tanks to be covered with dust and rainproof covers.

which the incoming cold water extracts heat from the outgoing hot water. Apparatus of this kind is bulky and fragile and unsuited for field service conditions.

The use of porcelain filters is also impracticable on active service, owing to the ease with which these are broken.

87. If water-bottles, water-carts, storage tanks and other containers used for the storage and transport of drinking water are dirty, the labour of purifying water becomes useless. It is therefore of great importance that all water containers should be kept clean and frequently sterilized.

Containers (including water carts and bottles) may be sterilized by filling them with bleaching powder solution twice the strength of that used for drinking water.

Water-bottles may also be sterilized by filling them with boiling water or boiling hot tea. The corks of water bottles frequently become dirty and slimy, and should be scrubbed with boiling water or a strong solution of bleaching powder.

88. Water points should be established at every halting place on the lines of communication and in forward areas as necessary. Every water point (Fig. 15) should have facilities for the filling of water-bottles, as well as water carts.

It is essential to establish good water discipline in every unit, so that the best use may be made of the facilities provided, and to ensure that drinking water is never taken from unauthorised sources.

AIR AND VENTILATION.

89. Ventilation means the provision in a room or hut or other enclosed occupied space of air in the state most beneficial for the human body. It thus means the continuous supply of pure, fresh, cool, moving air, and the removal of warm, moist, used air, without the discomfort of an appreciable draught.

90. Ordinarily, air which has been expired is warm, and rises above the cooler air to the upper part of a room, where outlet ventilators are placed to allow it to escape. The fresh air enters from any lower apertures in the room, windows, doors, etc., to replace it, and as it in its turn becomes warm by passing into and out of the lungs, it also rises and escapes, so that with proper inlet and outlet apertures in the room a continuous circulation of fresh air results.

91. The apertures by which the ventilation of rooms is normally carried on are the doors, windows and chimney—the chimney being of special importance when fires are burning, because the hot air from the fire passes up the chimney, thus causing a general flow of the air of the room towards the fire

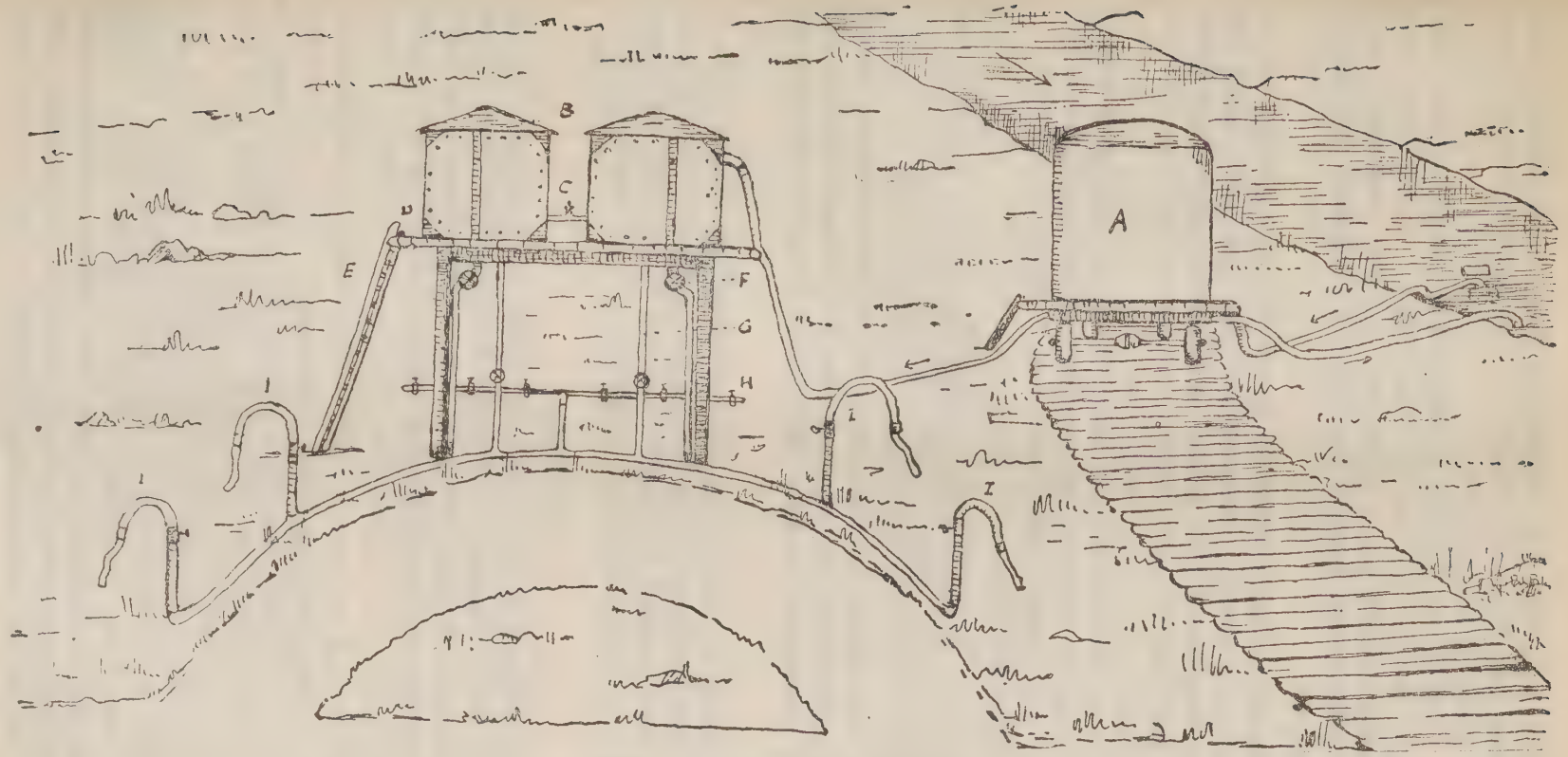


FIG. 15.—A Water Point.

A.—Water purification lorry.
B.—Two 9,000 gallon tanks with depth gauge.
C.—Connecting pipes with disconnecting tap.
D.—Platform with "E" ladder.
F.—Spigot and pipe for emptying.
G.—Delivery pipe.
H.—Taps for water bottles.
I.—Standard for filling carts.
J.—Sleeper way.

NOTE.—Total capacity of tanks 9,000 gallons for 1 or 2 standards, 18,000 for 3 or 4 standards.

and greatly aiding the circulation of fresh air through the room. In fine weather all windows should be thrown open whenever a room is unoccupied.

It is just as important that at night the room, where men are sleeping, should be freely ventilated. This does not mean that men should be cold in bed; on the contrary, they should be comfortably warm, but the air breathed should be cool and fresh.

92. A minimum cubic space is required for each person in an occupied apartment; otherwise the foul air could be changed by means of the usual ventilating apparatus only at such a rate as would create an uncomfortable draught (*see* Appendix II).

In addition a minimum floor area for each occupant and a minimum space between adjacent beds is essential to lessen or prevent the spread of germs by "droplet infection" (*see* paras. 116 and 265).

93. Germs of all diseases, especially such diseases as cerebro-spinal meningitis, consumption (tubercle), pneumonia, sore throat, influenza, etc., are likely to be communicated from one man to another in rooms that are insufficiently ventilated, especially if the men are too close together on account of reduction in the superficial area or linear wall space.

94. The readiest test of the efficiency of the ventilation of a room is the freshness of the air on first entering it from outside. The test should be made at night time when the men are in bed. A stuffy smell is evidence of bad ventilation.

CLOTHING.

95. The clothing to be worn on home service and in the various stations abroad is prescribed by regulations. Considerable discretion is granted to local authorities as regards the wearing of certain important articles, such as greatcoats and helmets.

96. Men are apt to wear articles other than the regulation boots and underclothing, and, although this irregularity may appear a trivial matter, much importance must be attached to the proper protection of the body from heat and cold and to the prevention of foot soreness.

Boots of a civilian type, for example, are frequently of a wrong shape, crushing the foot into bad position, or are too light for marching purposes. Cotton shirts, also, cause much more rapid chilling of the body, when wet with perspiration after heavy work, than does the regulation shirt of wool or a mixture of wool and cotton.

97. The uniform should not be made too tight. A loose coat protects the body from cold better than a tight one, and also allows the heart and lungs to act more freely, thus enabling work to be done without distress (*see* paras. 18 and 19).

Whenever possible, especially in hot weather, the coat should be opened at the neck during heavy work, and duties should be performed in shirt sleeves.

98. The proper fitting of boots is essential to good marching and must be supervised personally by company and platoon officers. When a man is being fitted with boots he should be in full marching order (the fit of boots is altered when carrying a load), and the boots should be inspected with the man standing up in them.

Boots must not be allowed to become hard. The practice of putting the wet soles on the bars of a hot grate or exposing the boots to a fire when wet destroys the leather. Instead, the boots must be dubbed, or greased, and kept supple.

Puttees should be somewhat loosely wound and usually require some adjustment in the early stages of a march.

99. Socks must be properly darned, and every man should be taught to do this for himself. Socks with holes or bad darns cause sore feet. Socks must be washed and changed frequently.

100. Underclothing must be regularly washed and attention paid to the airing and changing of shirts. This is of special importance in the field, where verminous conditions are so likely to occur if cleanliness of underclothing is neglected (*see* para. 173).

101. The actual load carried by the soldier (*see* para. 20) greatly influences not only his marching efficiency, but also his fighting efficiency at the end of a march.

The present load of the infantry soldier cannot be increased without bad results, and the inclusion of unauthorised personal articles in men's marching kits must be strictly controlled by company officers.

PERSONAL CLEANLINESS.

102. Personal cleanliness is essential from every point of view and must be encouraged and facilitated. Arrangements for ablution and bathing are important in barracks but are of even greater importance in camp and on service, where facilities may have to be improvised.

103. Keeping the feet clean is especially necessary in the case of the soldier, as dirt leads to sore feet, and the result of neglect of the feet is inability to march.

Cleanliness of the hands and particularly of the finger nails is most necessary, more especially of the men whose duty it is to handle food. The hands should always be washed throughly after using the latrine. In fact, cleanliness in every form cannot be too strongly urged.

104. Bedding and towels should not be used by others than the men to whom they belong, and in cases of infectious or verminous diseases they should be disinfected. The bedding and towels of men reporting sick should be labelled with A.F. G. 1022 and kept separate from the bedding, &c., of other men, until disinfection has been carried out or has been proved to be unnecessary.

105. The hair must be kept closely cut, brushed and combed daily and frequently washed. Hair brushes are often neglected; they should be washed at least once a month.

106. The teeth must be cleaned at least once and preferably twice a day; the best time to use the toothbrush is before going to bed. Decaying or painful teeth should receive treatment at once and must never be neglected.

ALCOHOL AND TOBACCO.

107. The effects of alcoholic beverages upon the body are to stimulate the action of the heart for the moment followed by a reaction during which the body loses heat and is less able to resist cold, though a false feeling of warmth is produced. There is stimulation of the nervous system and of the mental faculties, but even a small dose of alcohol causes diminished speed and accuracy in acts requiring skill or dexterity. In small quantities alcohol has a definite food value.

If consumed in large amounts any value which alcohol may have is lost and the poisonous effects of excess inevitably appear.

Alcohol, in fact, is a luxury, not a necessity, and, while no harm is likely to ensue if it is taken in moderation, the habit of drinking to excess is easily acquired and causes grave injury to health.

108. The question of issuing alcohol to troops as part of their ration has long been a matter of controversy.

At present rum may be issued as part of the active service ration on the recommendation of a medical officer.

If issued, it should be given after the work of the day is over, when it helps to remove the sense of fatigue and to promote digestion; it should be taken with or after a meal, never on an empty stomach; and it is probably of most value shortly before men turn in for the night.

109. Tobacco smoked in moderation by grown men is probably beneficial rather than the reverse, inasmuch as it allays the feeling of hunger when rations are short, and is a comfort to those using it; on the other hand, if used in excess, especially by young men or boys, it has a bad effect. It may cause abnormalities in the heart's action, visual trouble and loss of muscular tone.

The smoking of large numbers of cigarettes, the practice of inhaling the smoke, and the use of strong roll tobacco may have a specially disturbing effect on the heart's action.

The chewing of tobacco is not to be encouraged, partly because it has a more powerful effect when chewed than when smoked, and because it leads to spitting, a habit that is dirty and objectionable at all times.

Men should not use one another's pipes, as disease (*e.g.*, syphilis) has been communicated in this way.

Tobacco is best smoked after meals, and should not be used just before doing work. Boys should be forbidden to smoke.

SANITARY TRAINING.

110. Sanitation in the army is a universal responsibility, and in no case limited only to the medical services; success in maintaining health and preventing disease depends entirely upon the co-operation which the medical services receive from every individual in the army. Sanitary measures must be, firstly, *understood*, secondly, *believed in*, thirdly, *practised* by every officer, non-commissioned officer and man.

Education and training in sanitation are, therefore, sanitary measures of outstanding importance and every officer must be capable of teaching this subject to his own men.

111. Equally important is the thorough and continuous training of regimental sanitary and water detachments (*see* para. 317) and of reserve personnel to replace casualties. There is a tendency to regard these detachments only as "war establishments" and to make little or no use of them in peace-time; this should never be permitted.

112. And, above all, the value of example must be recognised. If the kitchens and surroundings of officers' or serjeants' messes are insanitary, what is likely to be the condition of the regimental or company cook-houses and institutes? It is the duty of every officer and N.C.O. to be a sanitary example to those under him and to lead as well as direct them along the way to health.

CHAPTER V

SANITARY MEASURES UNDER SPECIAL CONDITIONS

113. The laws of hygiene, as already stated (*see* para. 9), are universal, but the actual practice must largely depend upon circumstances.

Sanitary measures will, therefore, vary according to the various conditions under which troops have to live and work, and the sanitary measures applicable to some special conditions of army life have now to be considered.

BARRACKS.

114. In barracks sanitation is much simpler, and it only requires attention to regulations to keep barracks in good order.

The water supply, means for removal of excreta and rubbish, for lighting, warming and ventilation, are all of a permanent nature, and the routine required in connection with them is chiefly carried out by barrack labourers.

Even in barracks, however, a great amount of harm may easily be done by neglect and ignorance of sanitary rules by the troops, and it is desirable that every man should understand the nature and object of the various devices in use for supply of water and removal of excreta and refuse, and that he should be taught simple rules for the preservation of his health and of that of his comrades in barracks.

115. General cleanliness of barrack rooms is important in regard to the health of the occupants.

Dust and dirt on the floor and walls are likely to contain harmful microbes, and must not be allowed to accumulate, or be disseminated on to the beds or tables or, in dining halls, on to the plates and other food utensils. Vacuum cleaning is the ideal method, but in its absence, if the floor is hard and smooth, it should be treated with a floor oil or sprinkled with tea leaves, damp sawdust or other suitable substance, or damp mopping may be employed, to prevent the spread of dust. It will also be necessary to wash the barrack room floor once a week.

In doing this only enough water must be used to scrub the floor and clean off the soap, and all excess of water should be mopped up as the scrubbing proceeds.

The washing should be done in the morning to allow of the drying of the room before bedtime, and doors and windows must be left open and a fire lighted, if possible, to hasten the drying.

In wet weather the washing should be reduced to a minimum.

A damp cloth must be used to remove dust from walls, &c.

Cleaning utensils must be kept in their proper recess. Mops and scrubbing brushes have often an objectionable smell, and must not be kept in the barrack rooms.

Coal boxes are a source of much dust and should be kept outside barrack rooms. They should not contain anything but coal and wood; men are apt to put into them fruit peelings, sweepings, &c., and very soon they become receptacles for all sorts of dirt unless a rigid rule is enforced. When no fires are used the coal boxes should be turned upside down.

116. In barracks at home 600 cubic feet of air space and 60 square feet of floor space are allowed for each man. In foreign stations these figures are somewhat increased (*see* Appendix II). Further, the beds in barrack rooms must be so arranged that each bed has 6 clear feet of wall space with an interval of at least 3 feet between beds; this precaution is of special importance in preventing the spread of cerebro-spinal meningitis, influenza, colds, and other diseases spread by "droplet infection" (*see* para. 265). Even the temporary over-crowding of a room, which diminishes the spaces necessary for safety, is productive of ill-health and actual disease.

117. Windows and fire-places act as ventilators in barrack rooms and, when rooms are unoccupied, all windows should be wide open. Special care is necessary to ensure that windows are kept sufficiently open at night.

During sleep the body is in a state of lowered resistance, and in barrack rooms the air is less pure than the outside air at night. When the full complement of occupants is present, it is especially necessary that the windows should not be shut contrary to orders, as is apt to happen in cold weather.

In addition to doors and windows, special ventilating apertures are fixed in barrack rooms, outlet ventilators in the upper part or ceiling of the room and inlet gratings lower down. Care must always be taken to ensure that these ventilators are free from dust and that they are not stopped up by the occupants of the room.

118. The water supply is governed by the Royal Engineers as to its source and fixtures, and by the Royal Army Service Corps as to its quantity. It is laid on in most cases, but cisterns and taps in barracks are under the charge of the occupants and require attention. Cisterns must be kept covered, and cleaned out at intervals. Drinking direct from taps must be strictly forbidden.

119. Kitchens require to be kept sweet and clean, and cooking utensils, tables, chopping blocks, and all receptacles for food should be cleaned at once after use.

Tea kettles and milk cans which are in use in dining rooms must be frequently inspected and kept clean.

The tables from which the men eat must be kept clean. The use of table cloths contributes to this.

Plates and basins must be supplied in sufficient quantity.

Larders and food stores must be kept scrupulously clean and free from all odours. The protection of food from flies (*see* paras. 203 and 204) is of special importance, and frequently requires particular attention in the case of foods laid out for sale on the counters of canteens and institutes.

In canteens and institutes cups and other drinking utensils must be cleansed by dipping the rims into boiling water in addition to the ordinary washing.

120. Latrines and urinals are in the charge of troops in occupation of the barracks, and are kept clean and flushed by them.

Latrine seats must be scrubbed with soap and water daily, and with one per cent. cresol once a week or oftener if soiled. It is essential that they should be dried after being scrubbed, in order to avoid giving the men any excuse for not sitting down, while using the latrines, and so fouling the seats. A supply of latrine paper is equally important. Such matters are apt to be forgotten.

121. Urinals, if neglected, become very offensive.

Slate urinals can be kept clean by simply rubbing pan oil into their surface once every two or three days. The lateral partitions should only be oiled half way forwards to prevent soiling of clothes with oil. The drain channels should be flushed with water daily.

The urine tubs which are still to be found in certain barracks for night use, require regular attention. The place where they stand must be made of concrete and cleaned daily with one per cent. cresol when the buckets are removed. There must be no smell from such an emplacement. The tubs themselves are removed each morning to a fixed place outside the barracks, emptied, and filled with water, which should stand in them all day; they are also oiled inside periodically.

Pail closets are sometimes used in barracks (*see* para. 129).

122. The receptacles for barrack refuse are under the charge of the troops. They should stand on a concrete platform. Contracts are made for the disposal of barrack refuse, such as vegetable parings and ashes.

Rules as to such disposal are made known locally; but from the sanitary point of view it is important that all putrescible refuse should be at once removed from barrack rooms, and that the ground around the receptacles should be kept scrupulously clean and the receptacles covered.

123. Surface drains are those that carry off the rainwater. They run into "gully traps" covered by iron gratings; these are under the care of troops, and the silt which runs into them has to be removed monthly.

The foul drains receive the contents of latrines, urinals and sinks, and at certain points manholes are made for their inspection and cleaning; they are in charge of the Royal Engineers, but are sometimes opened, inspected and flushed by the troops under R.E. supervision.

These drains are provided with traps and ventilating shafts to prevent the foul air from entering the building, and to allow it to escape above the windows.

These require attention by troops to keep them efficient and clear from obstruction.

124. There should be a sufficiency of fixed glazed earthenware basins in ablution rooms in barracks; these places must be kept clean and made as comfortable as possible. Wooden grids on the floor are desirable to give dry standing, and hooks on which to hang clothing, while men are washing, are necessary.

In barracks every man should have a hot bath at least once a week, free of charge, and to insure that this is done a bath register should be kept.

Bedding and blankets should be well aired as often as possible; sheets and bolster slips must be changed every fortnight and blankets once a year. Blankets must be marked with the army number of the user, to prevent interchange and consequent danger of spreading infectious or contagious diseases.

Bolsters and bedding should not be allowed to become lumpy.

STANDING CAMPS.

125. In standing camps provision has to be made for a prolonged occupation of the site, and the men may be housed in huts. As contrasted with temporary camps, standing camps may be expected to provide a higher standard of comfort for the men. If troops are in tents, wooden floors may be provided.

Surface drains and roads should be constructed and in these camps, particularly, great care is necessary to avoid the fouling of the surface, for the longer camps are occupied the more are disease germs likely to gain admission and develop in them. When this occurs it is not easy to control their spread. The men are necessarily more closely together in camps than in barracks, and this fact in itself favours the communication of disease from one to the other.

The ground underneath huts that are raised on plinths must be kept clean; tent floors must be taken up frequently and the ground underneath exposed to the air.

Much may be done towards the prevention of disease by the occupants of the camp assisting in every way they can those whose duty it is to supervise sanitation.

126. A water supply system will be established, and the water laid on in pipes from specially bored or dug wells or other suitable sources of supply.

The area round water stand-pipes must be properly drained (Fig. 16) to prevent the ground from becoming water-logged.

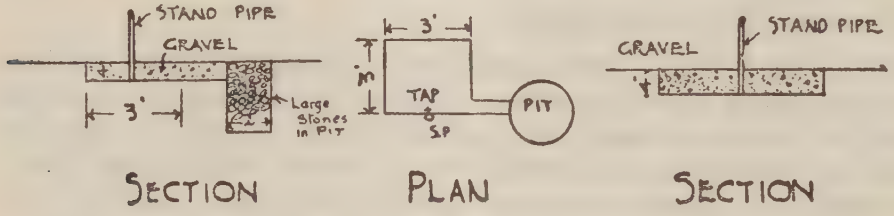


FIG. 16.—Surroundings of a water stand-pipe in camp.

To avoid the extra expense of purification a dual supply (one for drinking and cooking and one for ablution and laundry) is sometimes installed. In such cases all taps must be prominently labelled as "**Drinking Water**" or "**Not for drinking.**"

127. Permanent cook-houses and fly-proof food containers will usually be provided.

Cook-houses should be open shelters (Fig. 17), as these are less likely to be infested by flies than closed buildings. If fly-proof food storage is not provided it must always be improvised (*see* para. 204).

Field ovens must be constructed; there is no excuse for inflicting upon troops a permanent diet of stew (*see* also paras. 53 and 140).

The provision of dining huts or marquees is desirable wherever possible, to avoid men having to feed in their sleeping tents or huts.

128. Covered latrines and urinals will be provided, and a system of pail closets, with subsequent incineration of the contents, will commonly be used, but in large permanent camps a water-carriage system, as in barracks, will be found more economical and far more sanitary.

129. In a pail latrine it is essential that the pails should fit closely under the seat to prevent entrance of flies, that

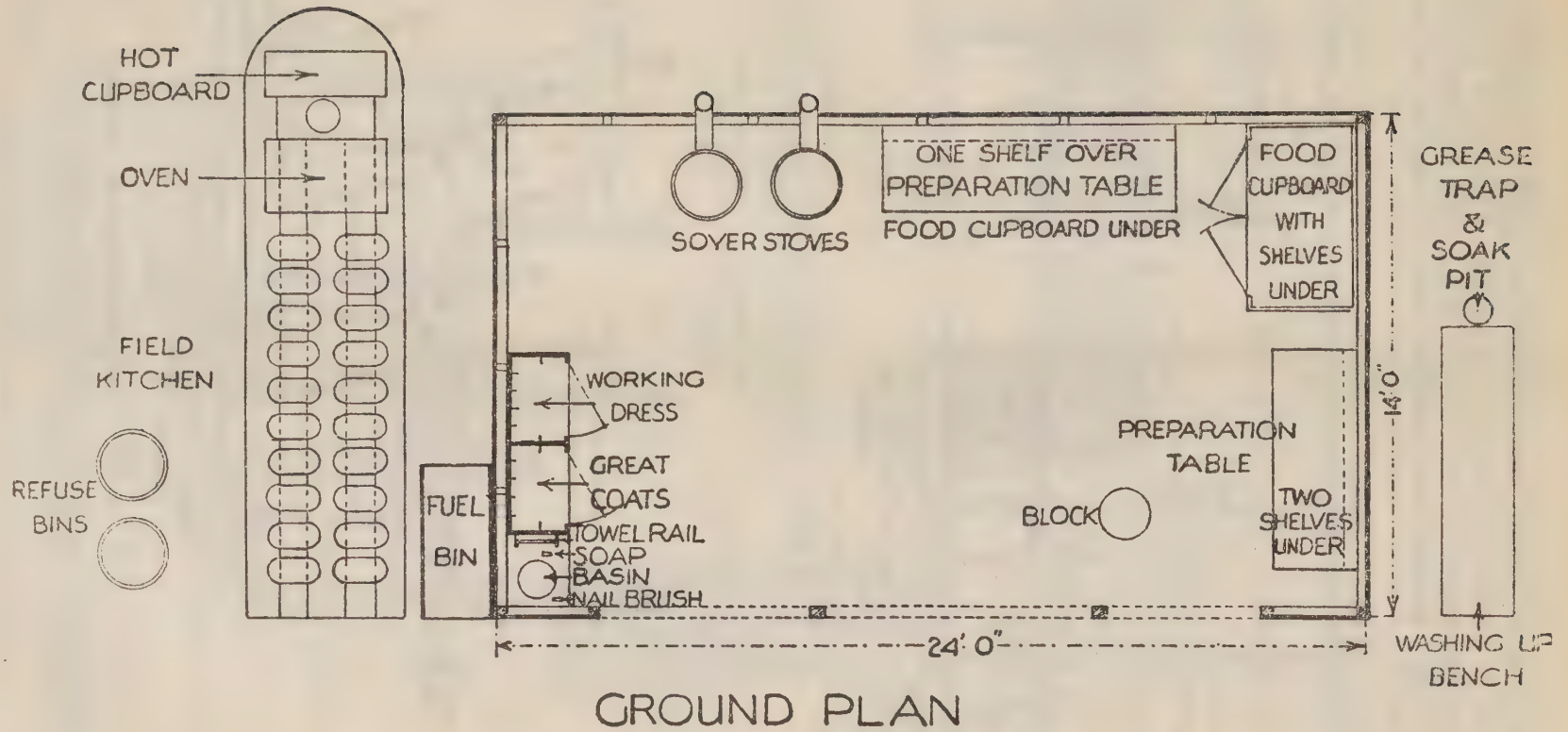
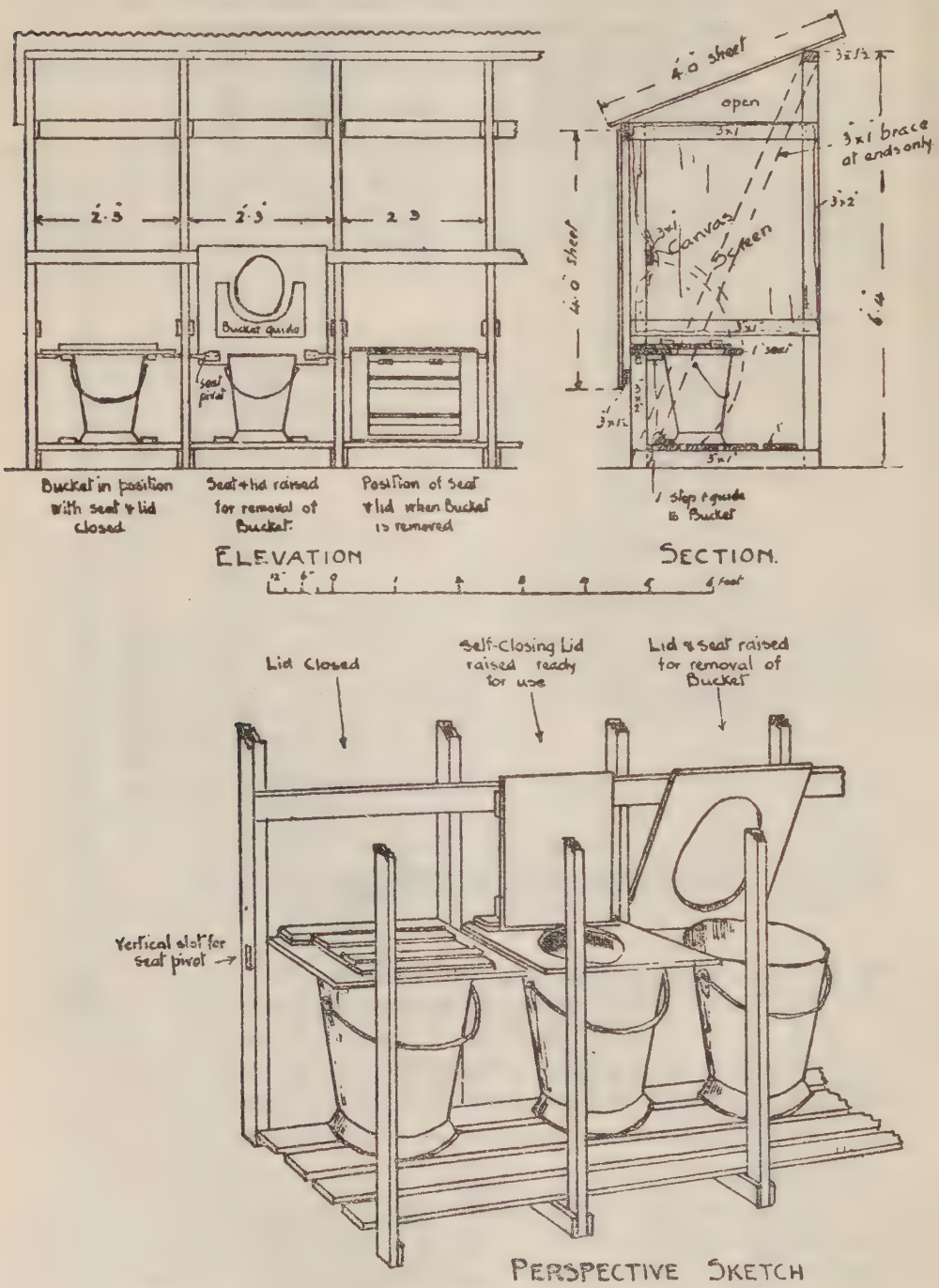


FIG. 17.—Type Plan of Cook-house. (Semi-Diagrammatic.)

the seat covers should be fly-proof and self-closing (Fig. 18), and that a sufficient supply of cresol should be provided.

Six latrine seats for every 100 men, with additional seats for N.C.Os., should be provided, and the supply of latrine



NOTE The guides & steps to Buckets should be so arranged that the seats & lids fit accurately over the Buckets and should be fly-proof.

FIG. 18.—Pail latrine for a standing camp.

paper usually requires attention. Latrines must have a light in them after dusk.

130. Trough urinals (Fig. 19) from which the urine passes by a pipe, covered with a grid, to a soak pit are the most useful type for a standing camp, where water carriage is not provided. Three should be erected near the tents for night use, one for officers and two for other ranks; also one near

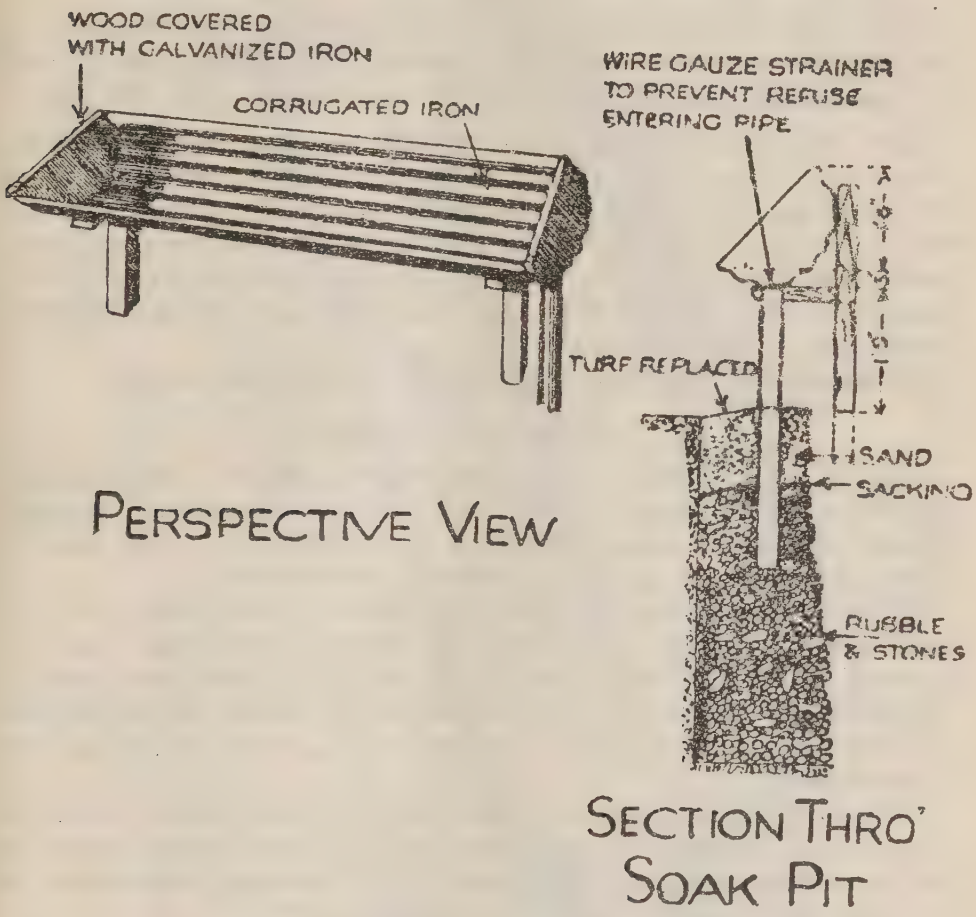


FIG. 19—Field Urinal (trough pattern).

the canteen. These should be lighted by a lantern after dark.

A soak pit 4 x 4 x 4 feet will deal with the urine of half a battalion of infantry in ordinary porous soil.

These urinals require the same care and treatment as in barracks (*see* para. 121).

131. Covered refuse receptacles (*see* para. 150) for the collection of general refuse in the camp lines must be improvised. From these the refuse should be collected twice daily and taken to the incinerator.

Kitchen refuse must be collected in covered receptacles and regularly removed for incineration, unless taken away by a contractor. Refuse receptacles should stand on a concrete platform to prevent foul matter from soaking into the soil around.

132. Incinerators for the burning of excreta and other refuse are usually permanent engineer structures, but, if not thus provided, they must be improvised (*see* para. 151).

133. The effective disposal of horse litter and manure is so closely connected with the prevention of flies that it will be considered under that subject (*see* paras. 188 to 194).

134. Ablution places (Fig. 20) are usually engineer structures, but may have to be improvised; the provision of a rail with nails or hooks on which to hang coats, shirts, towels, etc., and of a shelf on which to put tooth brushes and tooth powder is very desirable. Two soak pits, each 6 x 6 x 6 feet, should be able to deal with the ablution water of one infantry battalion if the soil is porous.

Bathing facilities are essential in a standing camp.

TEMPORARY CAMPS.

135. In the selection of camp sites, apart from tactical considerations, regard must be had to elevation, aspect, proximity of water, accessibility to roads, etc. Sites should always be selected as if for prolonged occupation.

High ground, grass covered and with a gentle slope, which facilitates drainage, is desirable; steep slopes, the base or summit of a hill, ravines and river beds, or tilled land should be avoided. If there is opportunity of choice in regard to soil, clay should be avoided and gravel, sand or chalk selected in preference.

Although the neighbourhood of trees is desirable, it is best not to form camps under trees or in places where there is thick undergrowth. Rank vegetation shows dampness of site and must, therefore, be avoided.

Camp sites, which have been occupied by other troops within the previous two months, should not be selected.

136. The ground should be prepared before tents are pitched, and long grass, stones, or rubbish should be removed.

Long grass and bushes within the camp harbour insects, hide refuse, and make it difficult to detect fouling of the ground.

Whether the camp is to be occupied for a short or a long time it is essential that the ground it covers should be kept clean, and this is materially aided by keeping the surface dry; channels should be cut to drain the ground and to carry off the rainwater from the trenches surrounding the tents.

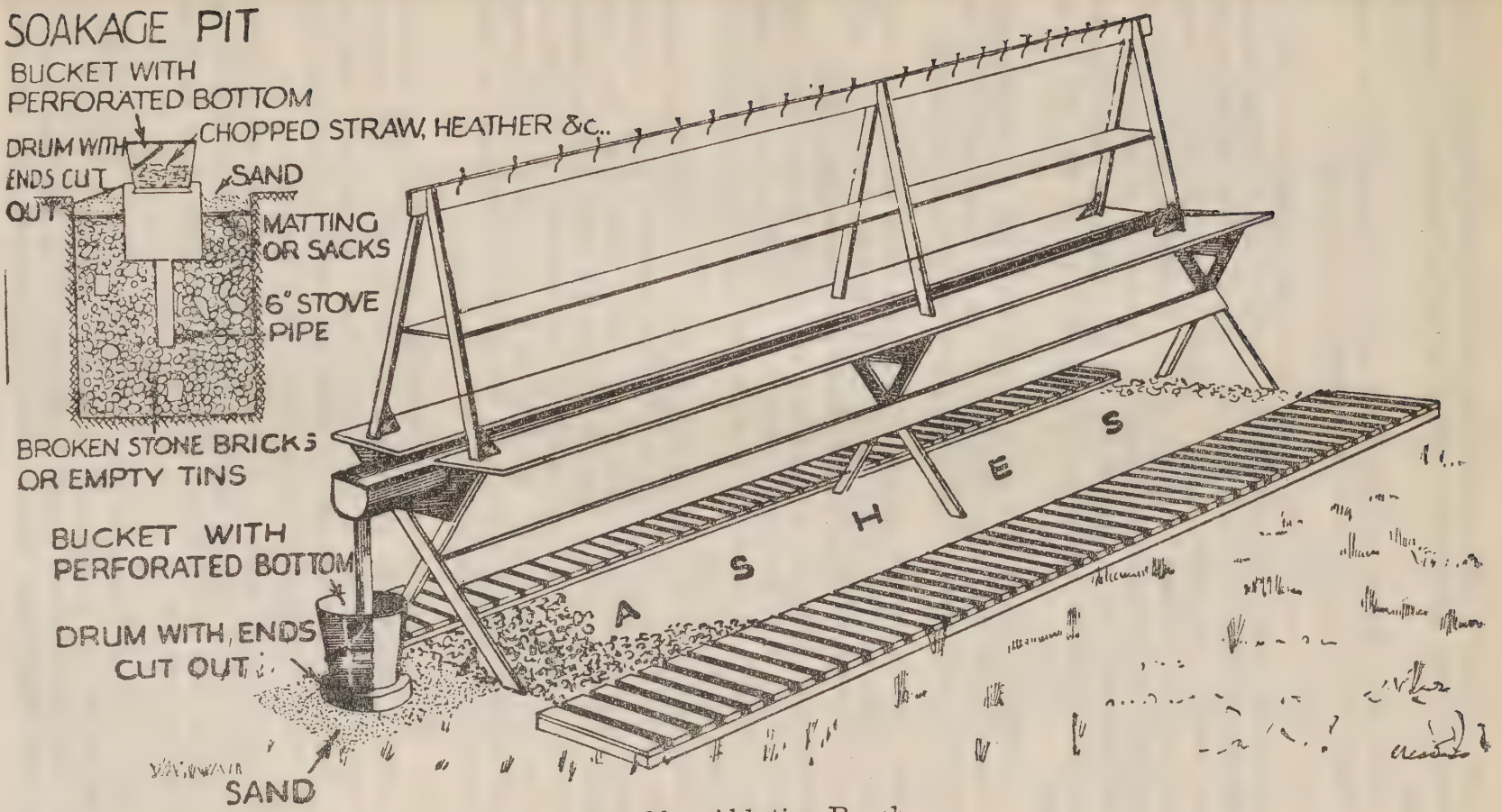


FIG. 20.—Ablution Bench.

The surface of the ground may be hardened by the laying down of gravel and paths may be formed of planking if obtainable.

When the camp is dusty and water is plentiful the roads through the camp should be watered to lay dust.

137. The form of the camp must be determined by the ground and the available space. Conservancy arrangements, such as incinerators, latrines and urinals, should be located in a single "sanitary area," usually in rear of the tents; cook-houses, messes, dining-tents, institutes, etc., should similarly be grouped together to form a "messing area", and these two areas should be as far apart as possible, and may usefully be separated from each other by the living tents.

A general guide to such an arrangement (Fig. 21) is possible, but conditions vary so much that no stereotyped plan can fit every case, which must always be judged on its merits.

138. Tent flies will be looped up first thing every morning; in wet weather this may be done on the leeward side only. Tent doors should face away from the prevailing wind.

When the camp is in existence for more than a few days, tents will be struck once a week, the ground underneath well swept and left exposed for some hours, and the tents replaced on their former sites.

Tents must never be re-pitched in the intervals of the former sites, as it commonly happens that refuse from tents, such as meat-tins, bones, washings from men's mess-tins, etc., are thrown on the ground outside the tents, and that at night men will urinate there, especially if the urine pits or receptacles are far away and there is want of supervision. All these cause fouling of the surface of the ground, and may become a grave source of disease.

139. Water supplies will be selected, protected and purified as already described (*see* paras. 60 to 88). The source of supply must be protected immediately on arrival, and the first troops to arrive are responsible for mounting sentries on all water sources likely to be required for use.

If the camp continues in occupation, the make-shift arrangements for water supply and purification, which have to be adopted at first, must be replaced by more permanent methods as soon as possible.

140. Cooking places require special attention, particularly in regard to the protection of food from flies (*see* paras. 203 and 204); they must be placed remote from the conservancy area and from horse lines. If the camp is in use for some

time, improvised shelter should be provided and the ground rendered impermeable by stones or cinders well rammed down.

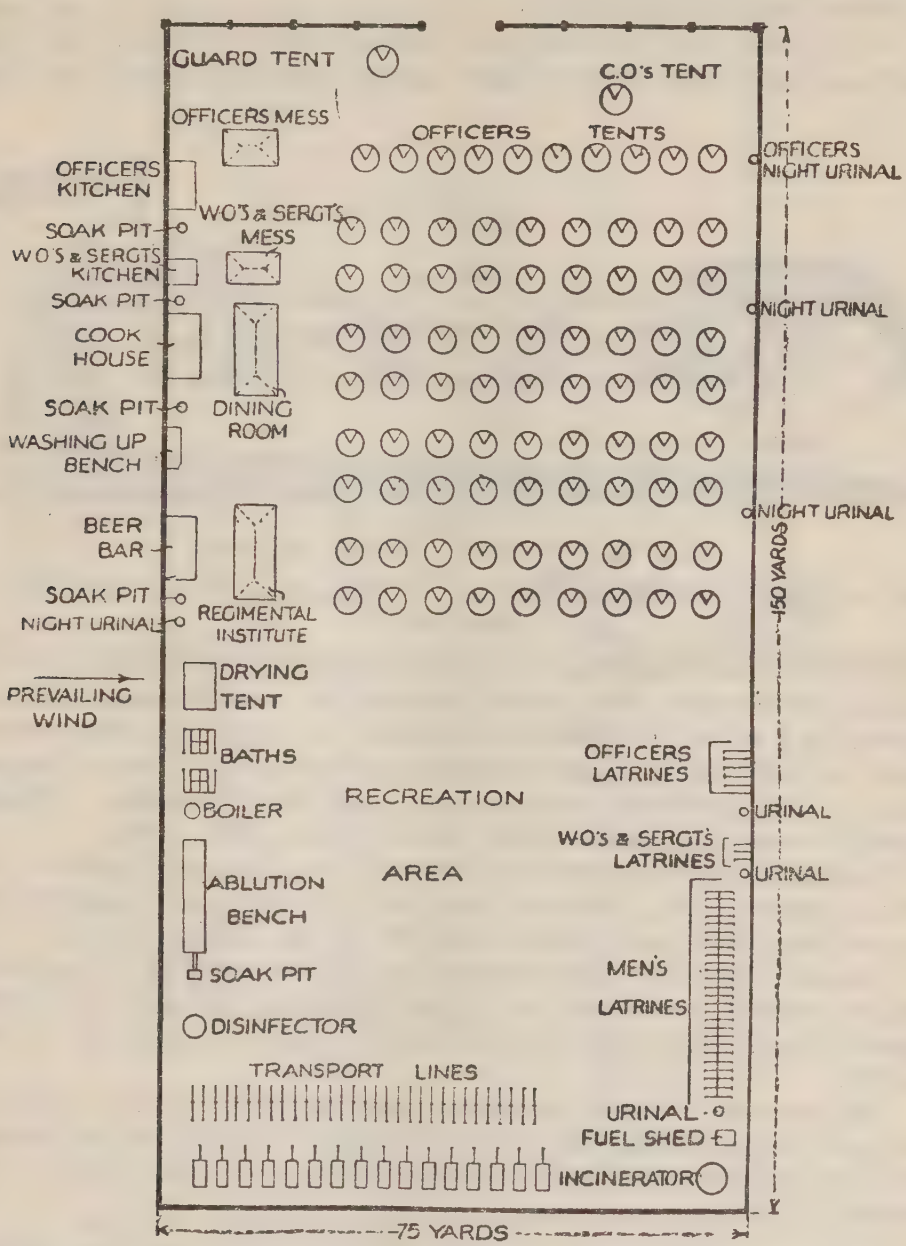


FIG. 21.—Lay-out of a camp site for a battalion to show the general sanitary principles.

Ovens (Fig. 22, page 54) should be constructed to provide variety in diet, and separate dining tents or shelters should be provided whenever possible.

141. Latrine accommodation should be provided for five per cent. of the troops in camp, but in bivouacs or camps

occupied for a single night three per cent. is sufficient. Latrine trenches must be dug immediately on the arrival of troops in camp so as to prevent the fouling of the ground by men on being dismissed.

142. Sites for latrines and urinals are selected by the staff and medical officers when laying out the camp, but the

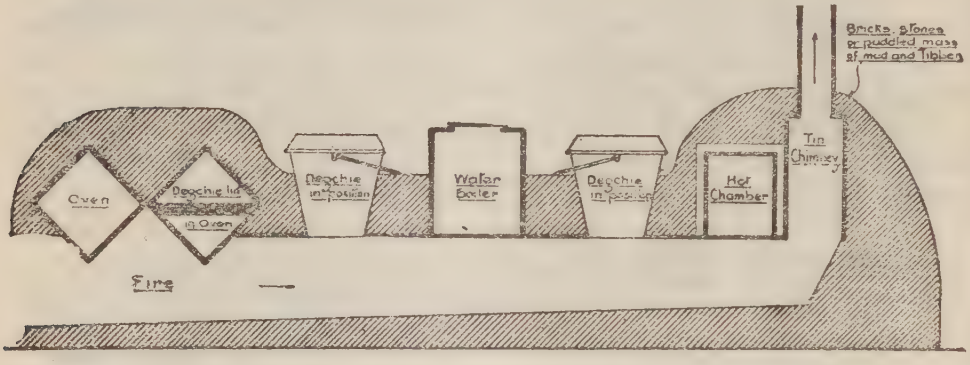


FIG. 22.—Section of Field Kitchen.

For outposts of 25 men—2 ovens, 2 degchies, 1 boiler and 1 hot chamber.

principles on which they are chosen should be known to all. To be inoffensive they must be sited at a sufficient distance from, and when possible, to leeward of tents; but they must also be sufficiently near the tents to make their use at night easy. One hundred yards is the prescribed distance. Night urinals should be provided as described in para. 130.

Latrines and day urinals should be grouped together in the sanitary area, remote from cook-houses and where there is no danger of any water supply being contaminated.

Latrine paper should be supplied (if the supply of paper is short, issues to cooks and food handlers should be given preference), and both latrines and urinals should be lit at night.

The ground in front of urinals and latrines is very liable to become fouled and sodden. It should be sprinkled daily with cresol solution and covered with dry earth, gravel or ashes.

143. Various types of latrine are used in camp, but, whatever form is adopted, it is essential to prevent excreta ever remaining uncovered and to avoid access of flies.

144. When permitted by the sanitary authorities, deep trench latrines (Fig. 23) are the best type for use in temporary camps where the nature of the soil is suitable. They should not be dug in chalk soil, as there is risk of contaminating water supplies, and in sandy soil they require revetting with

corrugated iron, wood or sandbags. Their construction is somewhat difficult when the soil water reaches a high level.

Fly proof seats, with self-closing lids, are essential; all boarding must be tongued and grooved, cracks tightly caulked and the seats kept in good repair (*see* also para. 195).

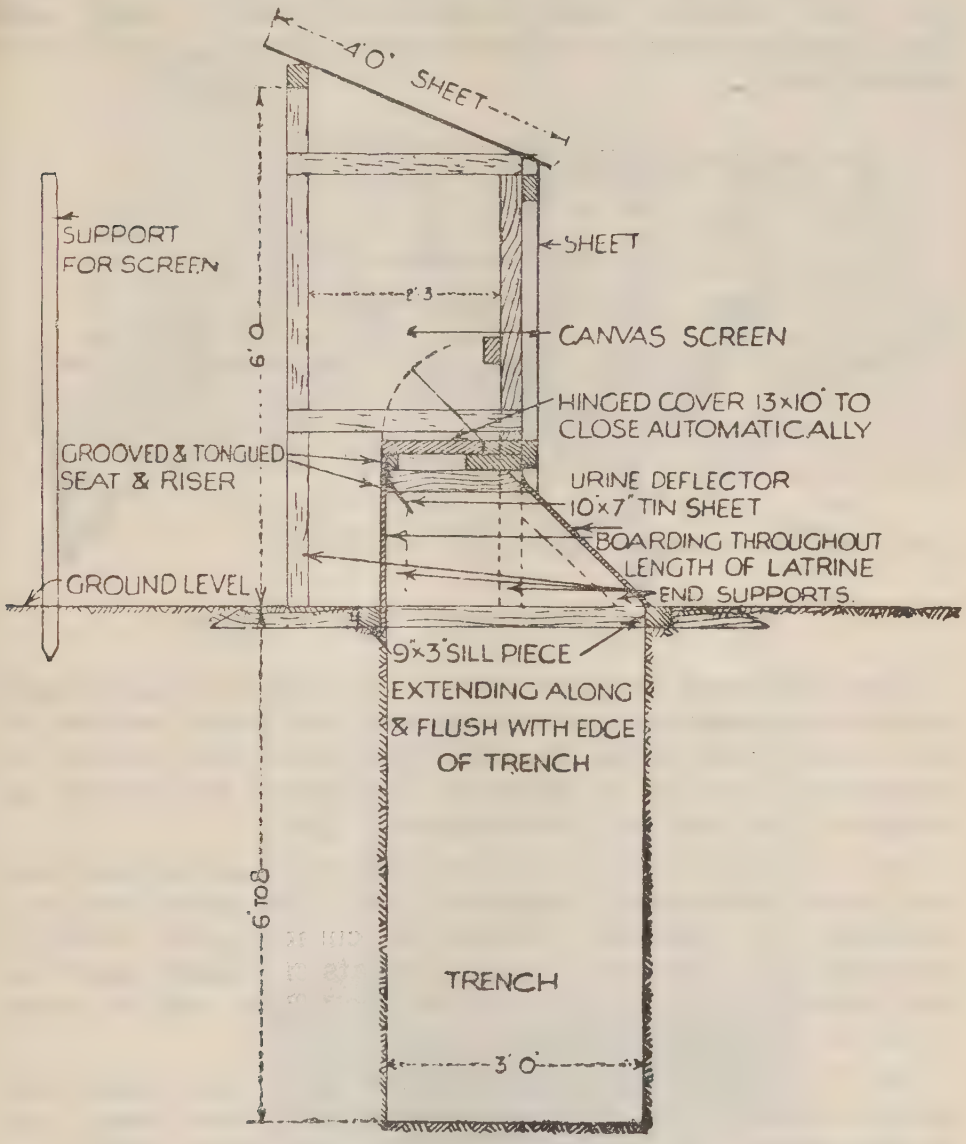


Fig. 23.—Field Latrine. Deep Trench fly-proof type.

145. Shallow trench latrines (Fig. 24, page 56) are solely for emergency or very temporary use; they can never be regarded as a good type for a camp of any long duration.

They are essentially a type of latrine suitable for use at mid-day halts on the march or for a bivouac or camp lasting not more than three days. In all other cases the covered deep trench or the pail latrine (*see* para. 129) must be used.

Where shallow trench latrines are in use they must be continuously policed by the unit using them to ensure that all excreta is *completely* and *immediately* covered with earth.

146. On no account should latrines be allowed to become over full. Shallow trenches should be filled in daily, and deep trenches when the filth reaches to within 2 feet of the ground level.

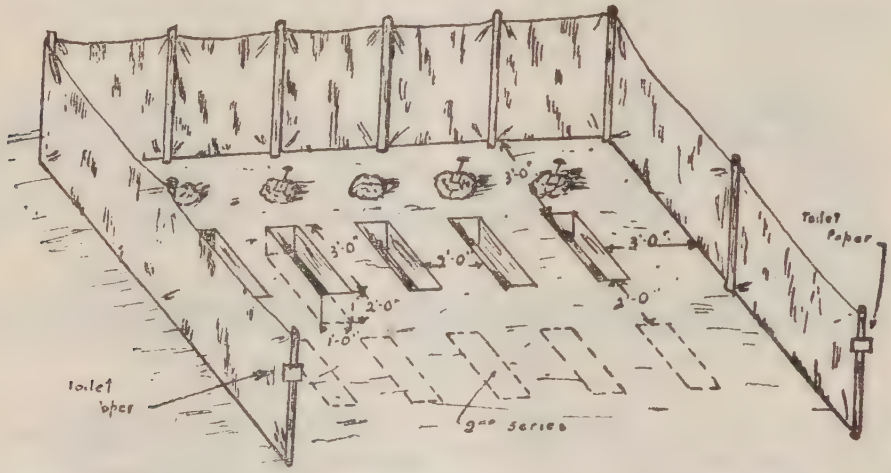


FIG. 24.—Shallow Trench Latrine System.

Their site must be marked by an L in stones so that no new troops occupying the camping ground may pitch tents on or near them, and before the turf is replaced they should be covered by sacking or sheets of oiled paper to prevent the escape of flies hatched from deposited eggs.

147. Urinals as described in para, 130 should also be provided, and their conservancy supervised with the same care as is necessary for latrines. Uncovered cubical pits, filled if possible with perforated tins, brick-bats or clinker, should be used solely for emergency, *e.g.*, on the march, and in camps of one or two days' duration.

148. Kitchen refuse readily decomposes, and invariably attracts flies. The washings of pots, &c., are greasy, apt to decompose and become offensive; moreover, the grease tends to block drains and interferes with the action of soakage pits. A simple method of disposing of this kitchen water is to throw it into a covered soak pit fitted with a kerosene tin covered by sacking and containing grass or brushwood, which should be changed and burnt daily (Fig. 25, page 57).

A better form of grease trap consists of a cold-water chamber, divided by baffles so arranged that all water must pass beneath them in its passage through the trap. Grease is solidified, rises to the top and is held back by the baffles (Fig. 26, page 57).

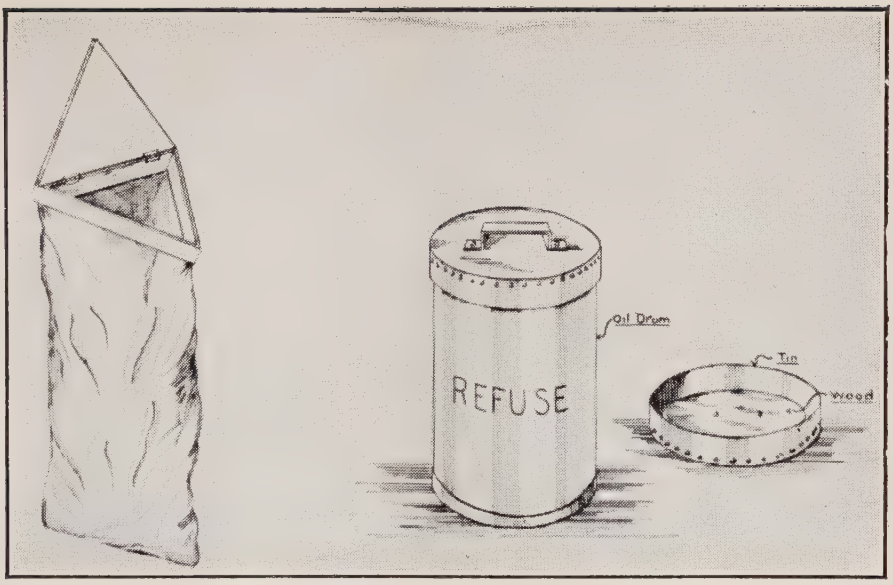


FIG. 27.—Fly-proof Rubbish Sack. Fly-proof Bin and Cover.

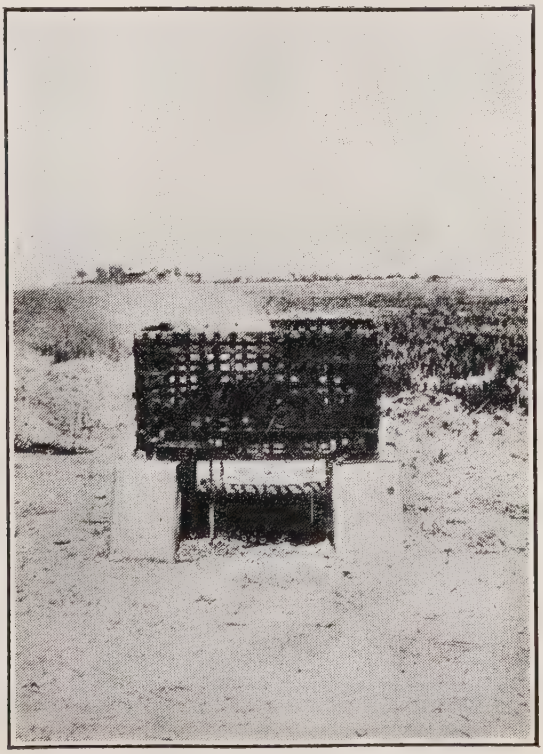


FIG. 33.—Basket Incinerator.

149. The horse lines must also be kept very clean, and horse dung removed and disposed of daily, as not only do flies breed in it, but it gets blown into food and water.

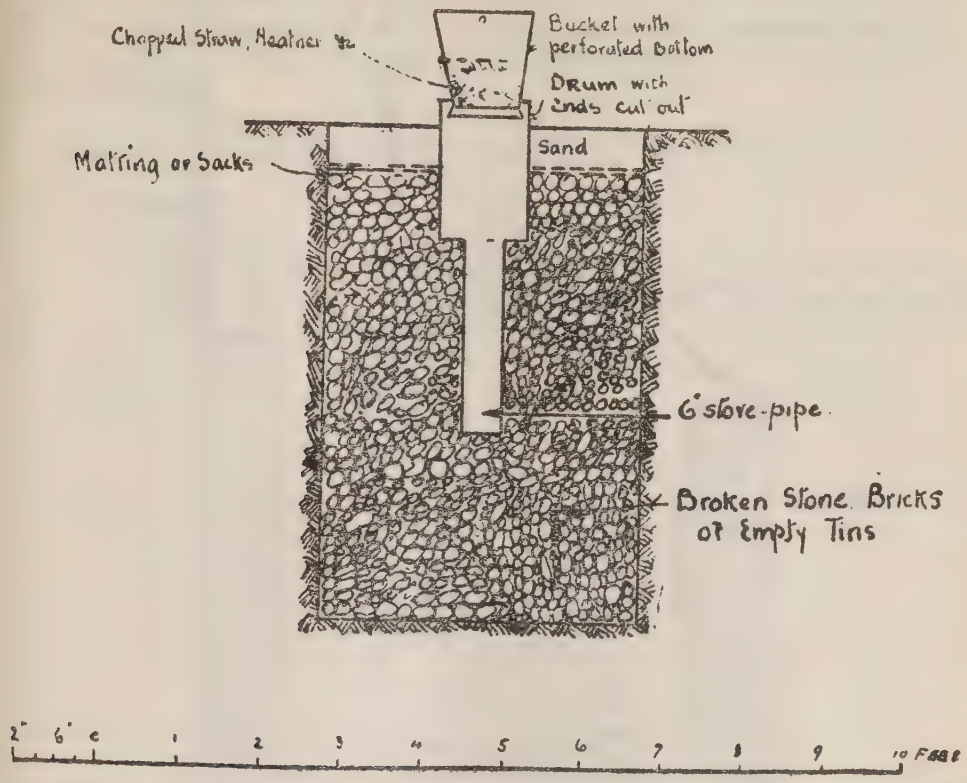


Fig. 25.—Soakage Pit. For Kitchen and Ablution Sullage Water.

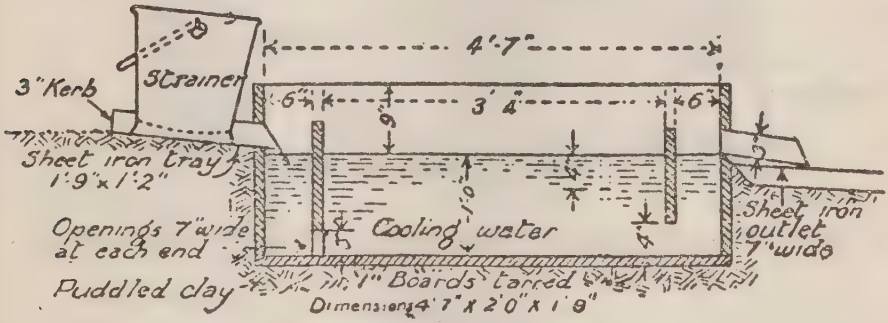


Fig. 26.—Grease Salvage Trap.

Horse manure is so favourable a breeding material for flies that its disposal is considered under that subject (*see* paras. 188 to 194).

150. In camp equipment no temporary receptacles are provided for tent refuse. They must be improvised from biscuit tins, boxes, sandbags, &c., placed near the tents, and emptied daily into the camp incinerator (Fig. 27, page 56).

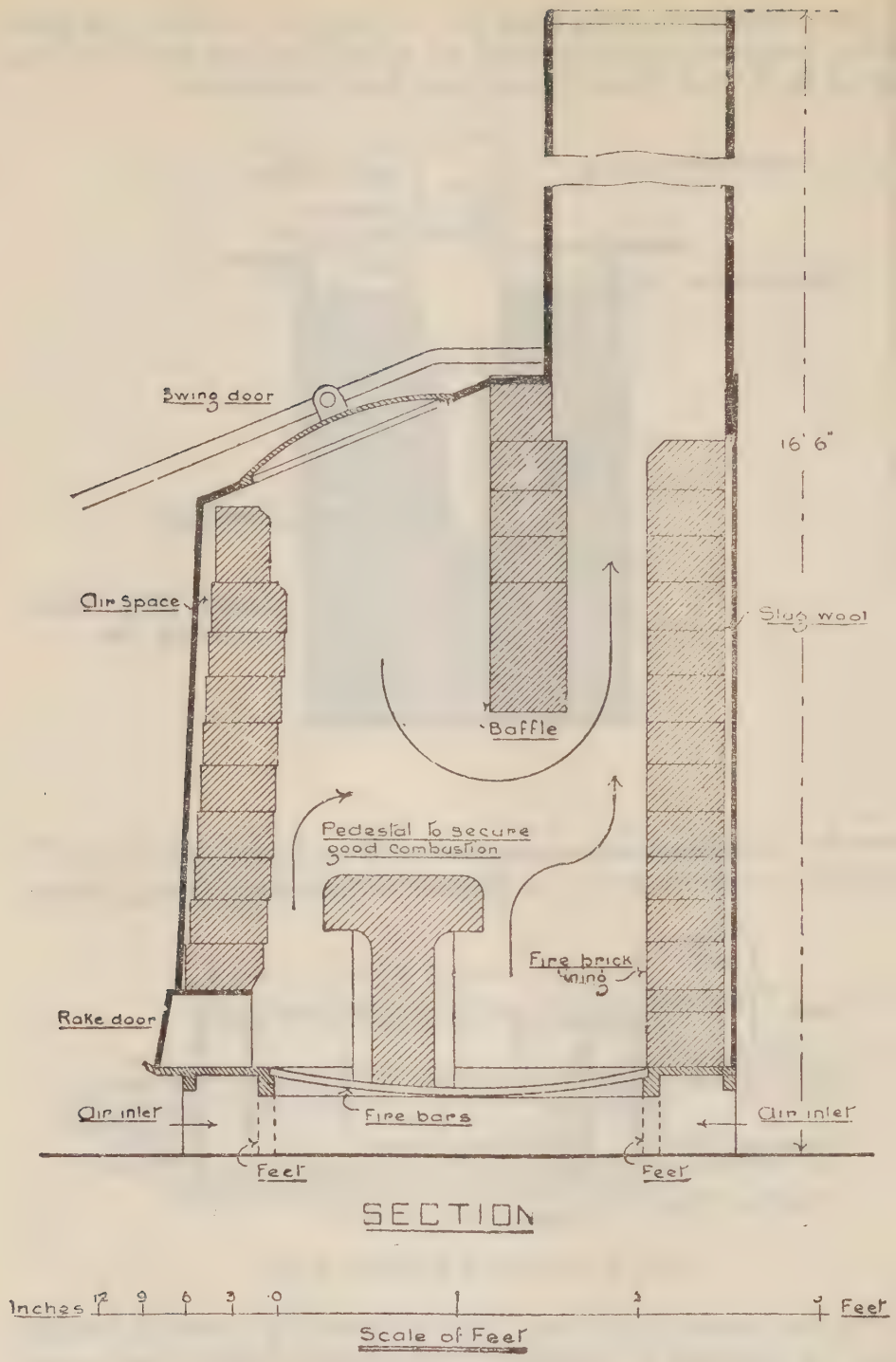


FIG. 28.—The Horsfall Destructor.

151. The best way of disposing of all animal and other refuse is by burning. Incinerators present a host of varieties, but all are generally included in two types, viz., closed or open.

Of the two, closed incinerators are the more efficient and should be adopted in standing camps. In temporary camps there is not usually sufficient time to erect one of the more substantial varieties of closed incinerator and in these circumstances an incinerator which can be rapidly constructed, such as that depicted in Fig. 30, or one of the open varieties, should be adopted.

The following are suitable examples of the two main types :—

1. Closed.

(*a*) The Horsfall destructor (Fig. 28). The framework of an incinerator of similar design can be made of biscuit tins filled with earth.

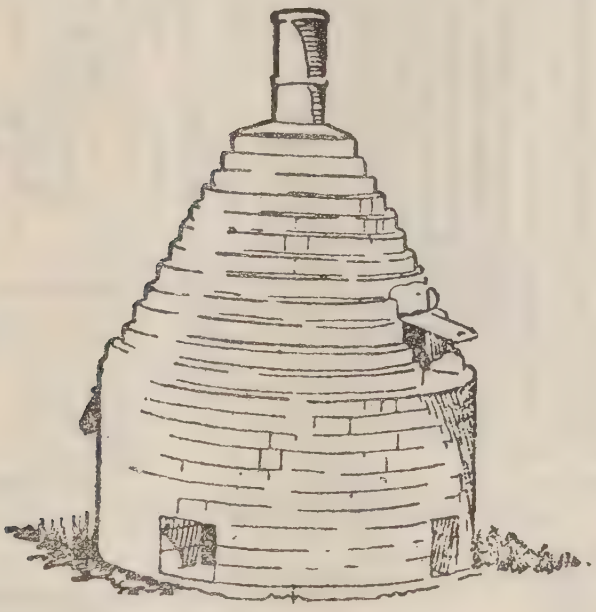
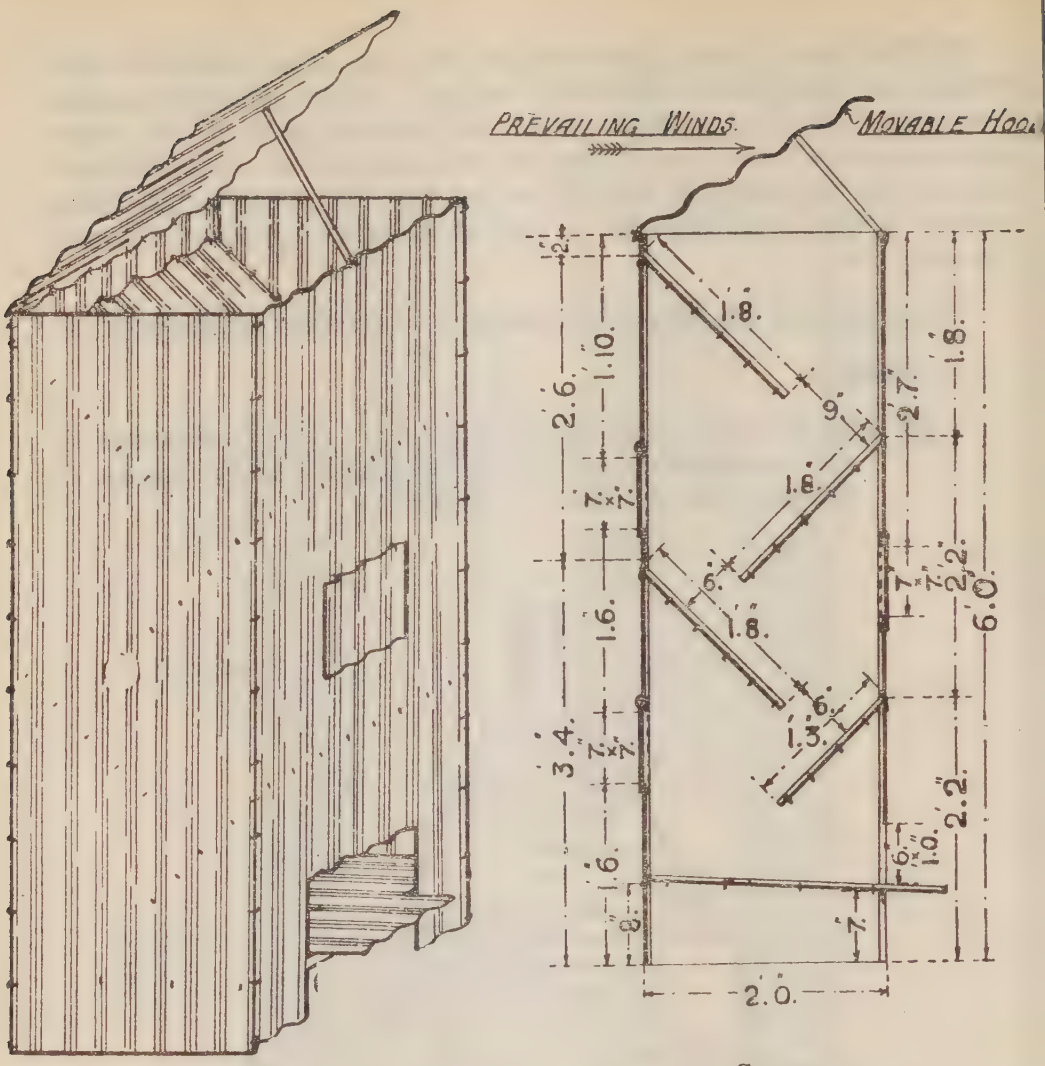


FIG. 29.—Beehive Incinerator.

(*b*) The Beehive incinerator (Fig. 29) is a simple design of closed incinerator which can be built by regimental sanitary personnel. Openings for filling and raking, with doors, must be made in the sides.

(*c*) An incinerator with graduated feed (Fig. 30, page 60) is simple in design, can be quickly constructed, and burns rapidly all forms of refuse. It is made from standard corrugated iron sheets, a few iron bars and wire.



SKETCH. SECTION.

FIG. 30.—Incinerator with graduated feed.

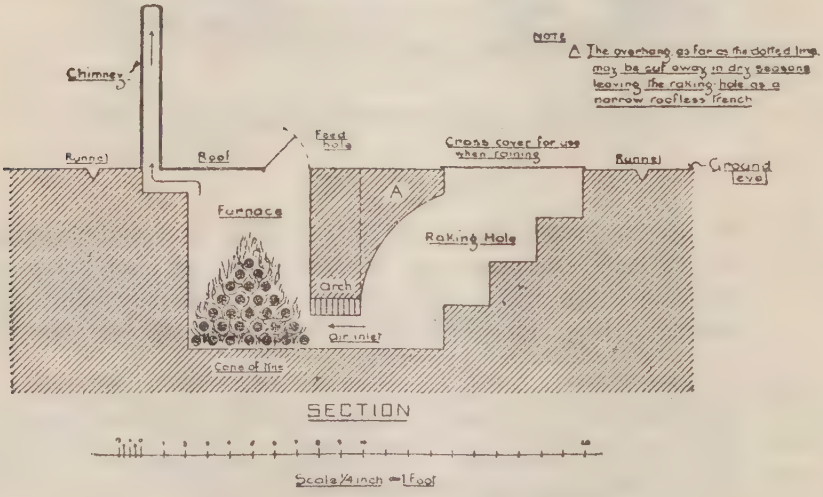
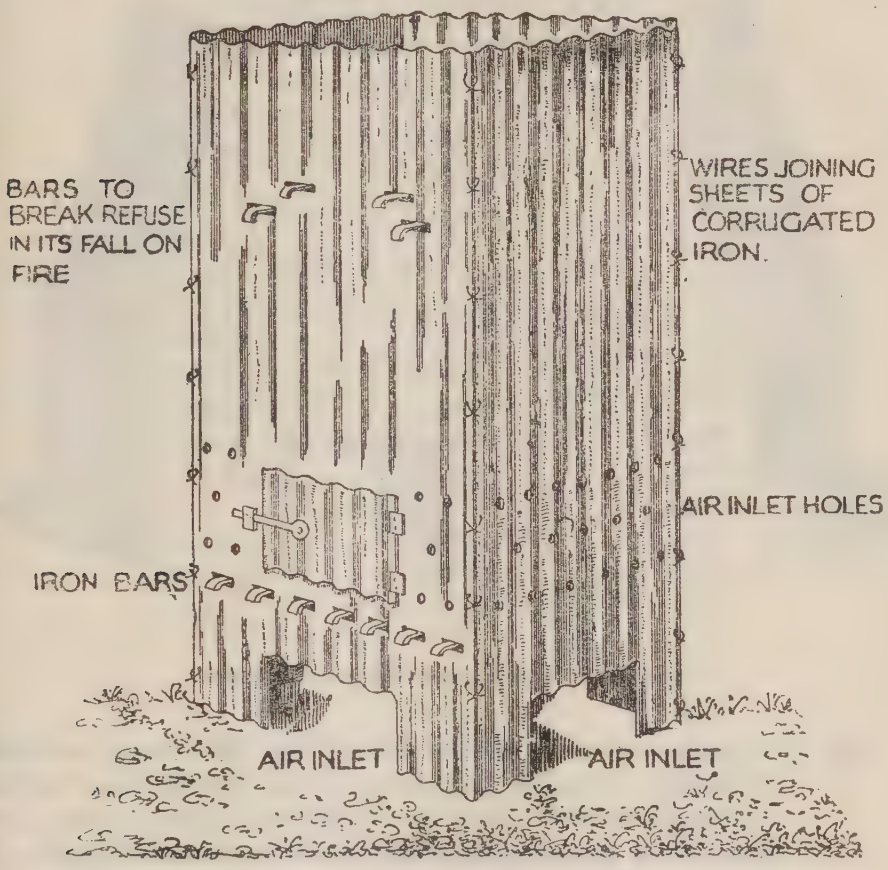


FIG. 31.—Dug-out Incinerator.

(*d*) The dug-out incinerator (Fig. 31) saves building and, in a suitable climate, is capable of burning horse manure as well as other refuse. It has the advantage that if a camp has to be finally vacated before all the manure or refuse is completely burned, it can be rapidly filled up with earth, thus burying the unburned contents. It has the disadvantage in wet weather of being liable to flooding.



Perspective Sketch

FIG. 32.—Vertical Corrugated Iron Incinerator.
4 ft. high, 2 ft. 3 in. wide.

2. Open.

(*a*) The vertical corrugated iron incinerator (Fig. 32) is made from standard corrugated iron sheets cut to four feet in height to facilitate stoking, these sheets are held together by wire and fire bars are provided as depicted. This incinerator and that shewn in Fig. 30 can be closed up, thus facilitating transport.

(*b*) The basket incinerator (Fig. 33, page 56) made of iron bands from tibbin (forage) bales and supported on petrol drums or biscuit tins filled with earth, is suitable for burning dry refuse or horse manure in small quantities.

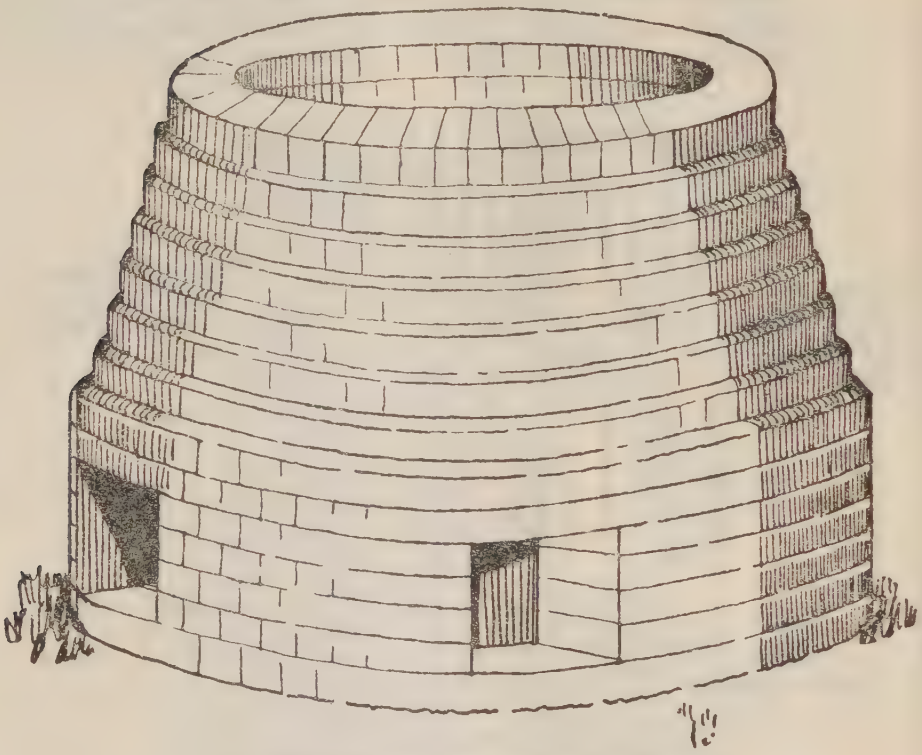


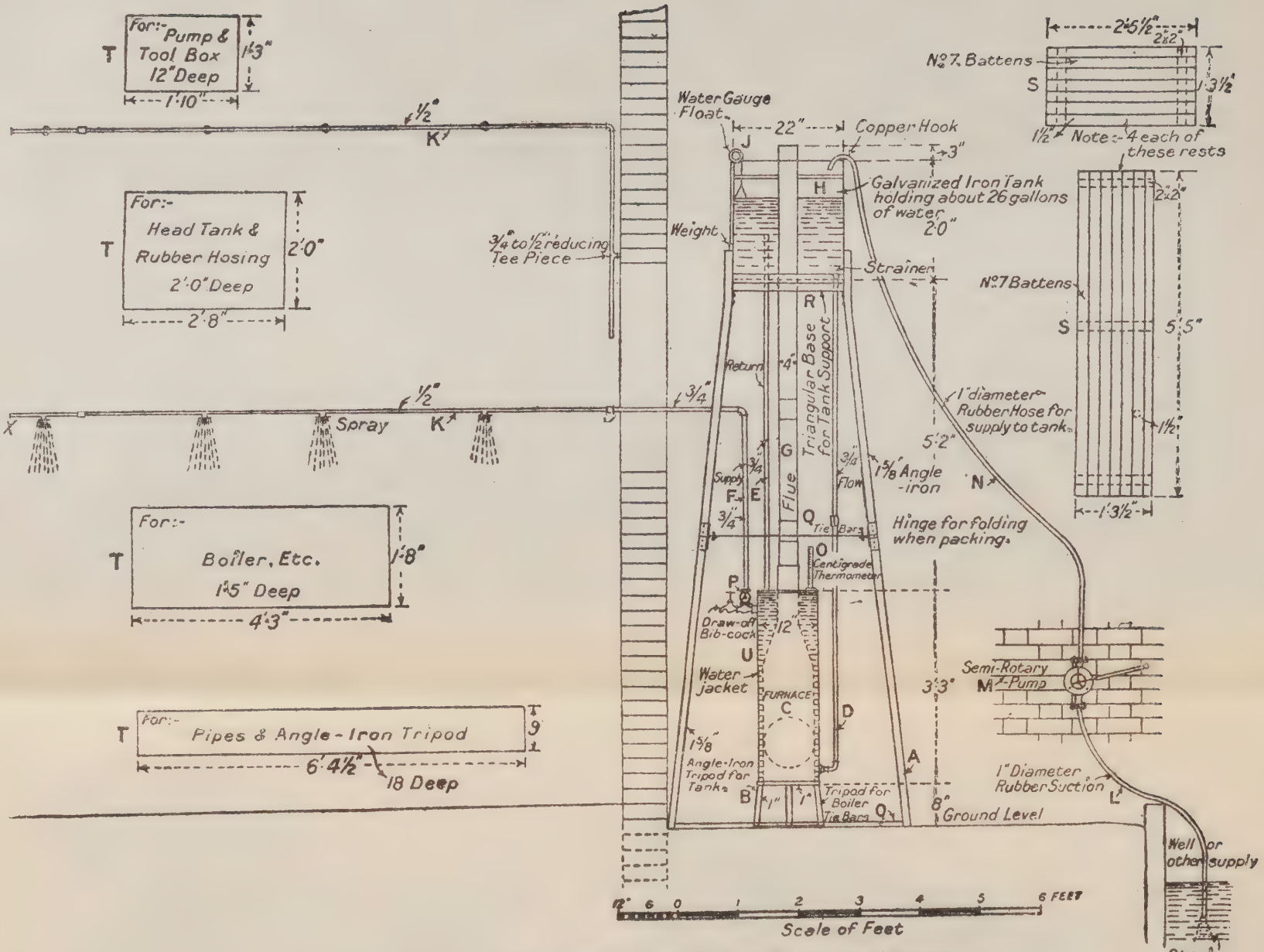
FIG. 34.—Open circular incinerator.

(*c*) The open circular incinerator (Fig. 34) may be built of bricks, stones, turf or old tins filled with earth. Draught holes must be sufficient and cross bars should be provided about one foot from the ground. It is necessary, should this variety be adopted, to make the incinerator round and not square, and the height not less than the diameter.

152. Disposal of refuse by burial is rarely satisfactory, and open pits or trenches must never be used for this purpose.

Where burial is necessarily adopted a covered pit with a fly-proof opening for filling (Fig. 35, page 63) is the best type. The pit is actually a covered cesspool, and the site must be carefully chosen to avoid all possibility of fouling the water supply.

153. Ablution places must be established and all washing done there. Slop water must not be thrown on the surface of the ground, but should be led by covered channels into soak pits.



SECTIONAL DRAWINGS OF TRANSPORTABLE SHOWER-BATH

A. Large Iron tripod
B. Small iron tripod
C. Furnace.
D. Flow pipe 3/4" leaving botton of cistern, entering lower end of boiler.
E. Return-pipe from top of boiler, entering cistern at 8 inches from bottom.
F. Iron pipe - 3/4" - from top of boiler to sprays.
G. Chimney, in 3 movable parts, fitting into one another.
H. Cistern.
J. Float, pulley & lead, attached to cistern registering depth of water.
K. Spray piping with 8 sprays.
L.& N. Two lengths of hose.
M. Semi-rotary pump.
O. Thermometer, registers to 100°C.
P. Pipe fitted with 2 cocks, a shut down for cutting off the sprays, & a draw-off bis cock for emptying cistern.
Q. Tripod kept in position by 3 round tie rods.
R. Triangular piece, fits into mortice one inch from top, on this cistern rests.
S. Footboards or foot rests.
T. Dimensions of four packing cases.
U. Water jacket or boiler.

FIG. 36.—Field bathing installation.

Bathing facilities should always be provided if at all possible. If the weather permits, bathing pools may be formed in streams. Shower baths (Fig. 36) provide the most desirable type of field bathing installation; failing these a marquee may be used, divided by canvas partitions into compartments, each containing a tub or other improvised bath.

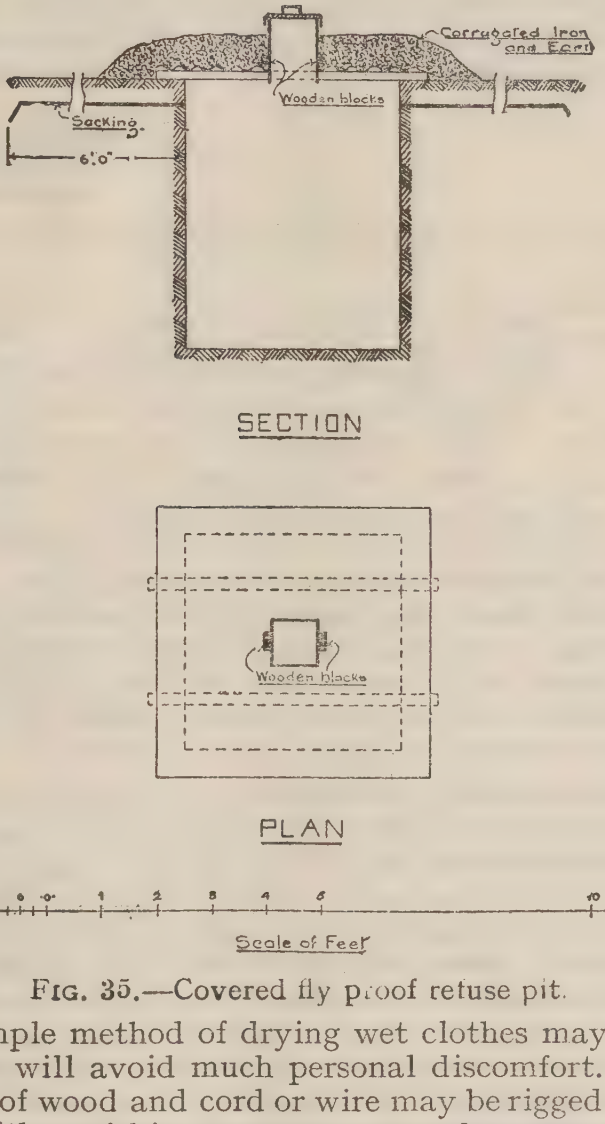


FIG. 35.—Covered fly proof refuse pit.

Some simple method of drying wet clothes may be devised and its use will avoid much personal discomfort. A simple framework of wood and cord or wire may be rigged up (Fig. 37, page 64), either within a marquee or under some shelter, and one or more braziers, improvised from old buckets or tins and burning coke or charcoal, placed inside.

It is of the utmost importance to avoid the necessity for drying wet clothing in living tents or huts.

BILLETS.

154. Billeting parties should invariably ascertain the source of the local water supply, the measures which may be

necessary to guard it from pollution, the sanitary system of the place, and should make enquiries as to the existence of infectious diseases. Sentries should be posted at the first opportunity over houses where infection exists, and over any other houses in which it is not desirable to quarter.

155. When billets are being selected prior to the arrival of troops, the local authorities should be asked to take steps to render as suitable as possible such premises as may not be in a sanitary condition; for example, by opening doors and

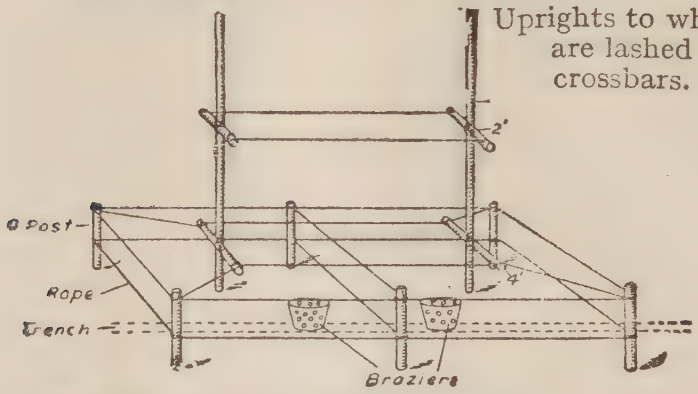


FIG. 37.—Frame for drying clothes in camp.

windows to give free ventilation, sweeping out or scrubbing any uncleanly floors, &c., according to circumstances and the time available ; assistance, if necessary, being given by the troops. Should it be impossible to render certain premises sanitarily safe, and no others are available, it is far more healthy for troops to bivouac.

156. In distributing men to the rooms of houses in a billeting area, it is desirable from a sanitary point of view that the following numbers should not be exceeded, namely, in rooms over 15 feet wide, but under 25 feet, not more than two men for every yard of length, or in rooms 25 feet wide and over, not more than three men for every yard of length. This amount of accommodation should suffice for one night; but even so much cannot always be expected, the areas allotted and the premises in them must be utilised to the best advantage.

From the necessary overcrowding it is obvious that great attention must be paid to ventilation.

157. While the municipal conservancy system of a modern town should generally suffice for the troops billeted in it, additional sanitary, especially latrine, accommodation will usually be necessary, at any rate for a short period, and particularly in close billets. Additional watering or washing-places may also be needed. In the event of a prolonged occupation special conservancy measures will be required.

In all cases the local authorities should be consulted, if possible, so that the improvised or special arrangements made may be suitable for the sanitary system of the town.

158. Incoming troops frequently complain of the condition in which billets, sanitary appliances, &c., have been left by their predecessors. This difficulty may be overcome by establishing a definite system of handing over billets; the quartermaster of an outgoing unit receiving a certificate from the responsible local authority or from a representative of the unit "taking over" to the effect that the billet has been handed over in good condition.

MARCHES.

159. The commonest causes of men falling out on the march are:—

Intestinal and stomach troubles, such as colic and diarrhœa.
Faintness from starting on an empty stomach.
Sore feet.
Heat.

160. The men should not start with the stomach empty; a crust of bread is better than nothing, and it should nearly always be possible to give each man, when breakfasts cannot be prepared and eaten prior to an early morning start, a cup of hot sweet coffee or cocoa and a biscuit.

It is inadvisable, however, to let men have a large meal till the march for the day is over. During the march alcohol should not be taken, and smoking should preferably be avoided until the march is over.

Overnight alcoholic excess and the eating of unwholesome food tend to intestinal complaints, and the faintness caused by marching on an empty stomach is frequently increased by over-indulgence in tobacco.

161. The causes of sore feet are ill-fitting boots (*see* para. 98), shrunken, badly darned or unmended socks, continued neglect of the feet, and such diseases of the feet as corns, bunions, &c.

Strict attention to the care of the feet is essential for marching troops, and a simple routine to be carried out at the end of each day's march is given in Appendix III.

162. Men are always more liable to fall out on a hot day than on one that is cool, because the heat produced in the body by the exertion of marching is not so easily removed. Excess of moisture in the air, buttoning up of the men's jackets, crowding the ranks together, all diminish evaporation by which the body is cooled; and these conditions have a specially harmful effect when the temperature of the air is itself high (*see* paras. 17 and 298).

163. Troops should start the march with their water-bottles full and should refrain from drinking for as long as possible. In a temperate climate men should be able to march between seven and eight miles without drinking, but thereafter the water lost from the body (*see* para. 21) must be replaced.

164. Rules for the march are to be found in Field Service Regulations, 1924, Vol. II, Sections 150 to 160.

Halts should be made as laid down in Field Service Regulations and the men should rest at the halt by lying down whenever possible. Sitting down involves nearly as much expenditure of energy as standing at attention. Stonewall Jackson's saying, " A man rests all over when he lies down," is worth remembering. On hot days the halt should be made in a shady place, but not necessarily if this entails halting in a stuffy hollow, for fresh air is more important than shade.

165. At all halts the strictest attention must be paid to the proper disposal of excreta. Water discipline especially in regard to drinking from dangerous or unauthorised sources must be strictly controlled.

TROOPSHIPS.

166. The reduction in cubic space and difficulties of ventilation, which are unavoidable on board ship, make the maintenance of general cleanliness a matter of very great importance. Troop decks must be swept after hammocks are down and before and after each meal. Ventilating openings must be kept free from dirt and must not be obstructed in any way. Men should be encouraged to sleep on deck whenever the weather is favourable and as far as space permits.

167. Personal cleanliness must receive attention and sail-baths should be rigged up for the use of troops. Ablution places are often cramped and require strict care to keep them sweet and clean.

168. On a long voyage lack of exercise tends to impair the fitness of troops. Arrangements should always be made to carry out physical training exercises, and voluntary physical work should be encouraged.

CAMPAIGNS.

169. Under active service conditions the various sanitary rules and measures already stated will hold good, though their practice often presents increased difficulties. War conditions, so far from furnishing any excuse for sanitary neglect, require even stricter sanitary discipline and procedure than in times of peace.

170. Conservancy arrangements are of special importance under war conditions, where, with improvised latrines and less possibility of food protection, the transference of germs from excreta to food is rendered easier.

In mobile warfare bivouacs and camps, even if occupied only for a night, must be left thoroughly clean for the sake of troops who may later encamp on the same site.

In trench warfare conservancy presents a difficult problem. The burning of refuse and fæcal material is generally out of the question and some system of burial has to be adopted. Where the water-level is suitable, fly-proof pit latrines placed in "T" saps can be used with advantage (Fig. 38); where the water-level is high or there is risk of

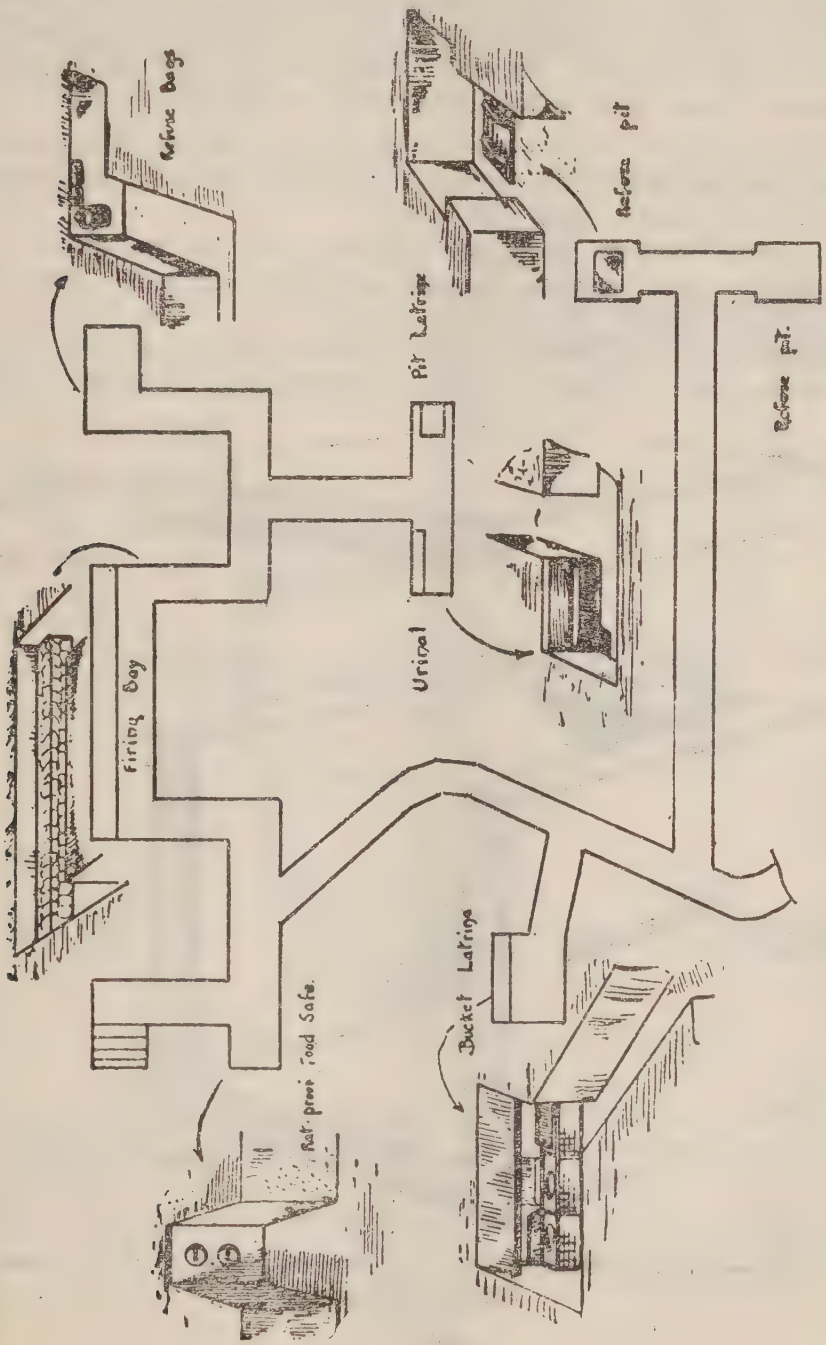


FIG. 38.—Plan of Trenches—showing sanitary arrangements.

flooding, receptacle latrines with fly-proof covers must be used. The contents of these receptacles must not be thrown into shell holes, but buried in pits well away from any occupied trench or dug-out. The site for refuse pits is chosen by the medical officer, generally in the neighbourhood of an abandoned trench. Two pits are dug about 4 feet deep, one for liquid and one for solid refuse. All refuse and excrement are emptied into these pits, and should then be sprayed with oil and covered with earth, a sacking cover being used where possible; when the unit is relieved, the pit must be filled in. Sandbags are suspended at convenient points in the trenches for the reception of rubbish, and on no account must any refuse be thrown over the parapet.

171. The risk of defective conservancy renders it necessary to pay special attention to the protection of food from dust and flies (*see* paras. 203 and 204).

In trench warfare food safes must also be rat-proof (*see* para. 260), and may be improvised from tins let into the walls of dug-outs.

Arrangements for the supply of hot food to outposts, men in trenches, etc., must be made. Food can be kept hot for

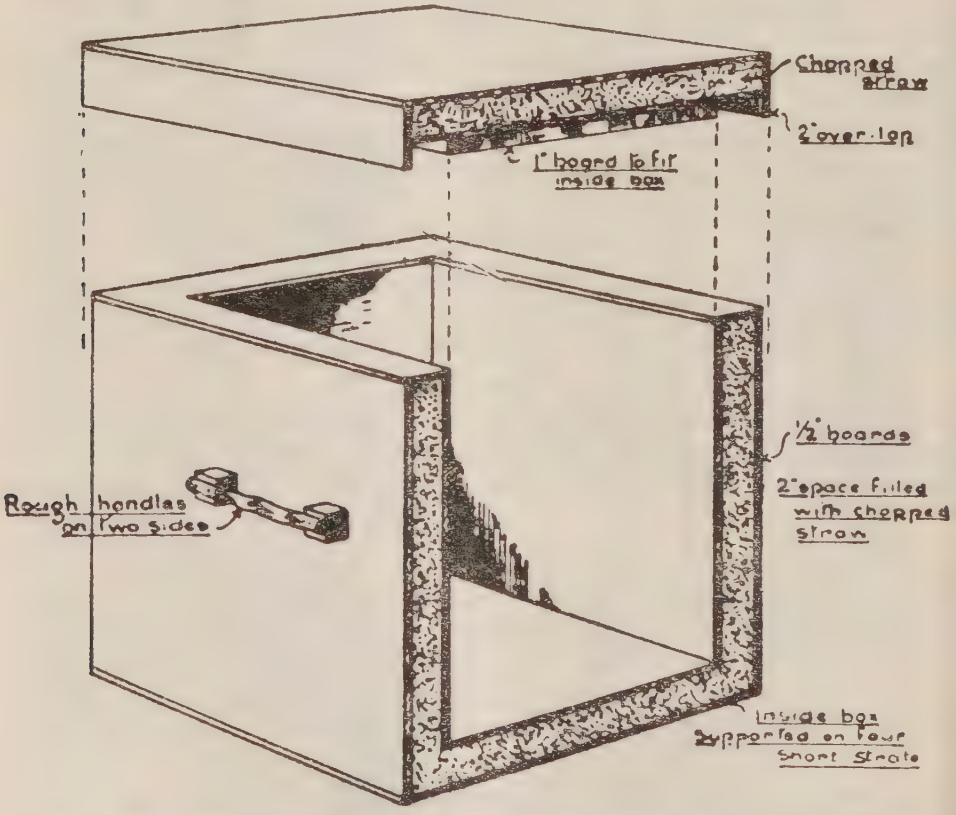


FIG. 39.—Jacketted Hot Box. One end removed to show construction.

several hours, if placed in a "hot box." This is a double box (Fig. 39) the space between the inner and outer casings being filled with hay, straw, paper, wool, etc.

172. Drinking water often has to be taken from doubtful sources, purification apparatus is limited owing to the necessity for mobility, and the time available for purification may be short; care in regard to drinking water becomes therefore of the greatest importance.

In trench warfare, the storage of water in trenches must not give opportunity for pollution; water points for storage (Fig. 40) should be constructed, the receptacles being covered and fitted with taps.

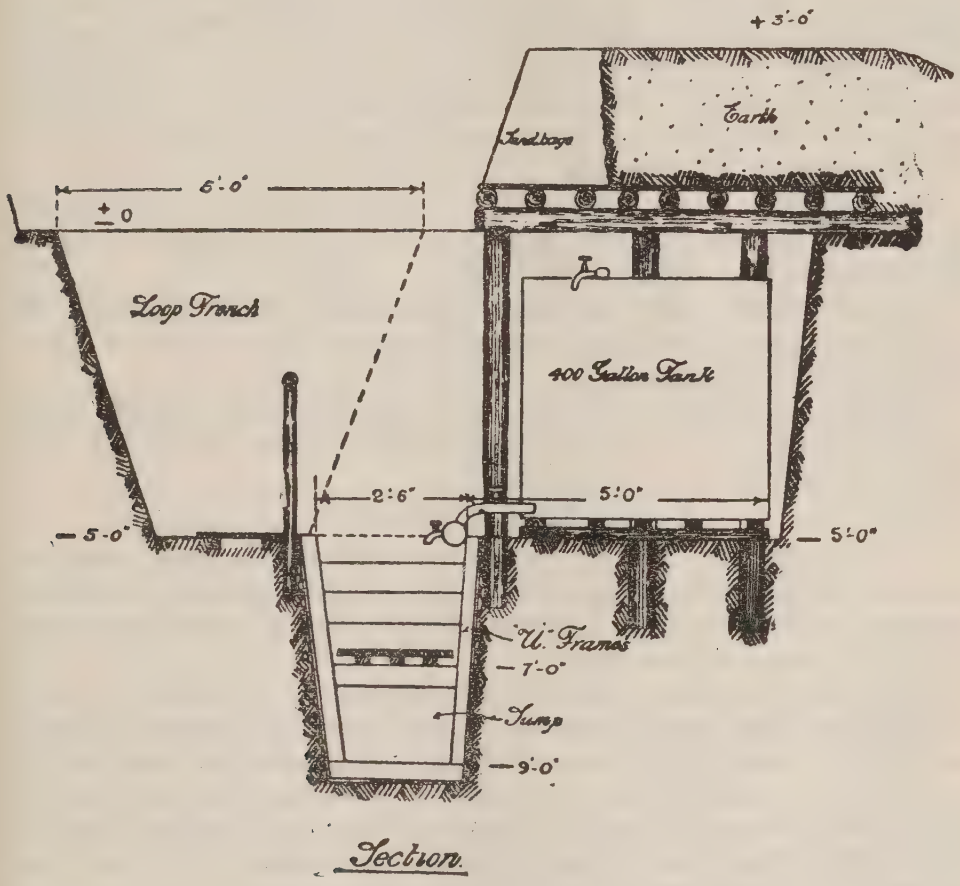


FIG. 40.—Water point in trench warfare.

173. Prevention of verminous conditions is a serious problem on active service. Strict attention to personal cleanliness, provision of bathing facilities, and personal measures against lice (*see* paras. 233 and 234), are essential.

In future wars it may be necessary to mobilise special cleansing units (*see* para. 319).

174. Sanitary measures and methods on active service depend largely upon, and vary with climate, season, locality, available material and the nature of the campaign; local schools of sanitation and courses of instruction therefore must be established in the actual theatre of war, so that men may learn the special dangers of the war area and the local measures which have been found suitable.

These schools are usually formed at the base, but facilities for revision courses are desirable even as far forward as corps or divisional areas. An example of such an arrangement is detailed in Appendix IV.

175. Movements on the lines of communication may involve prolonged journeys by rail, and the sanitary care of all entraining and detraining places or places en route where troop trains may halt is of great importance. Adequate latrine and urinal accommodation is necessary at every halt, also arrangements for the rapid supply of safe drinking water to travelling troops.

At selected halts additional arrangements for ablution, provision of hot water and meals, and covered messing accommodation must be provided.

Special permanent sanitary personnel is required at all halts, as troops passing through seldom have time to clean up the halting places.

Railway carriages, especially if upholstered, require constant attention and cleansing to prevent them becoming hotbeds of vermin.

TROPICAL STATIONS.

176. Sanitation in the East is fundamentally the same as in the West, but more stringent precautions are necessary to cope with the many dangers which threaten the European in his strange environment.

Climatic conditions favour the breeding of insects, many of which either directly or indirectly transmit disease. Many natives are carriers of the organisms of disease, more especially of dysentery and malaria, and from these reservoirs infection is likely to spread to any troops living in close proximity. Moreover, the fact that human excrement is used for agricultural purposes adds to the danger.

177. The climatic features of importance in tropical stations are a high atmospheric temperature and strong sunlight.

The result of exposure to a tropical sun without a helmet is well-known, and in hot climates the helmet must be worn from sunrise to sunset. Sun goggles should also be worn; whilst a spine pad and hand fan are useful additions to the equipment. Heatstroke is particularly liable to occur when the air is moist as well as hot, and when the evaporation from

the skin, which is the natural means of lowering the heat of the body, is consequently lessened. This is specially the case during hard work, when evaporation must be more rapid to restore the balance of body temperature.

In tropical climates the changes of temperature are often great, the heat of the day being followed by a cold night. Great-coats should always be at hand for men on sentry duty.

The wearing of a flannel belt at night in hot climates is of some value in preventing abdominal chill and consequent diarrhœa, dysentery or liver congestion.

178. Barrack rooms, huts, etc., are designed to exclude heat, are usually raised off the ground on brick piers, and are provided with shaded verandahs. Mosquito-proofing of dwellings is essential. Floor and cubic space (*see* Appendix II) is greater than at home.

The choice of camping grounds is important in the avoidance of malarial fever. The neighbourhood of collections of stagnant water, in fact wherever the Anopheles mosquito breeds, and localities where the natives are themselves sufferers from malarial fever, are especially dangerous sites.

179. In the diet the proportion of fatty and protein (meat) foods may be reduced with advantage, and the amount of fruit and fresh vegetables increased. Fruit and vegetables from local sources are often dangerous as the local cultivator habitually uses human excreta as manure; if eaten uncooked they should first be carefully washed in a solution of bleaching powder, being rinsed thereafter in purified water.

Mineral waters or ice-creams bought in bazaars are also most dangerous, as the water and milk from which they are made are almost invariably polluted.

In regimental mineral-water factories the water, if not obtained from a safe source, must be purified before use, and all bottles must be disinfected (by boiling water or steam) on return before being refilled.

Beer and alcoholic drinks, sold in Indian and other native bazaars, frequently contain spirits that are not sufficiently matured, and also other constituents which may have disastrous or even fatal effects.

In hot climates alcoholic drinks tend to sunstroke, and heatstroke, and it is an excellent rule never to take such drinks before sundown. On the whole, it is probable that better work will be done and health more easily maintained under conditions of total abstinence.

180. The disposal of excreta in the case of local troops and followers may present difficulties on account of native

and caste prejudices. In such cases frequent removal and early incineration of pail contents must be insisted upon.

Where such prejudice does not exist a platform placed over a deep pit with narrow openings and self-closing trapdoors may be utilised (Fig. 41).

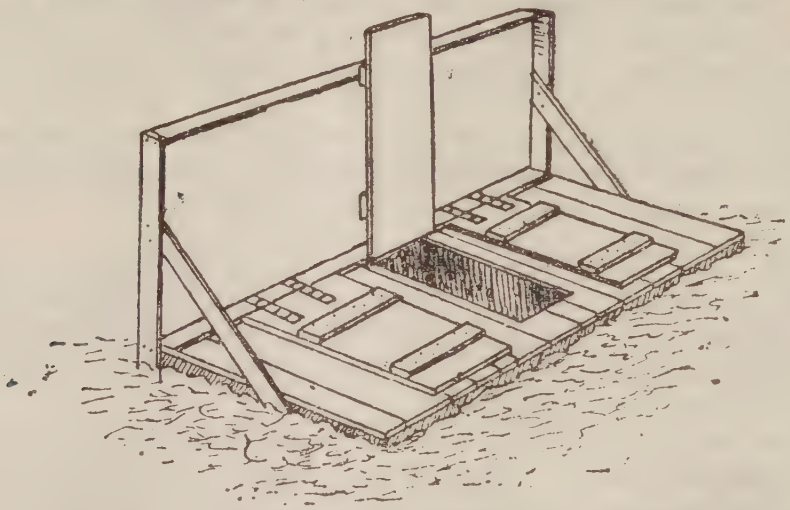


FIG. 41.—Deep trench latrine for non-Europeans.

It must be at ground level so that it can be used in the squatting position and foot-rests should be provided. In Indian latrines there should be separate tins for urine and fæces (Fig. 42).

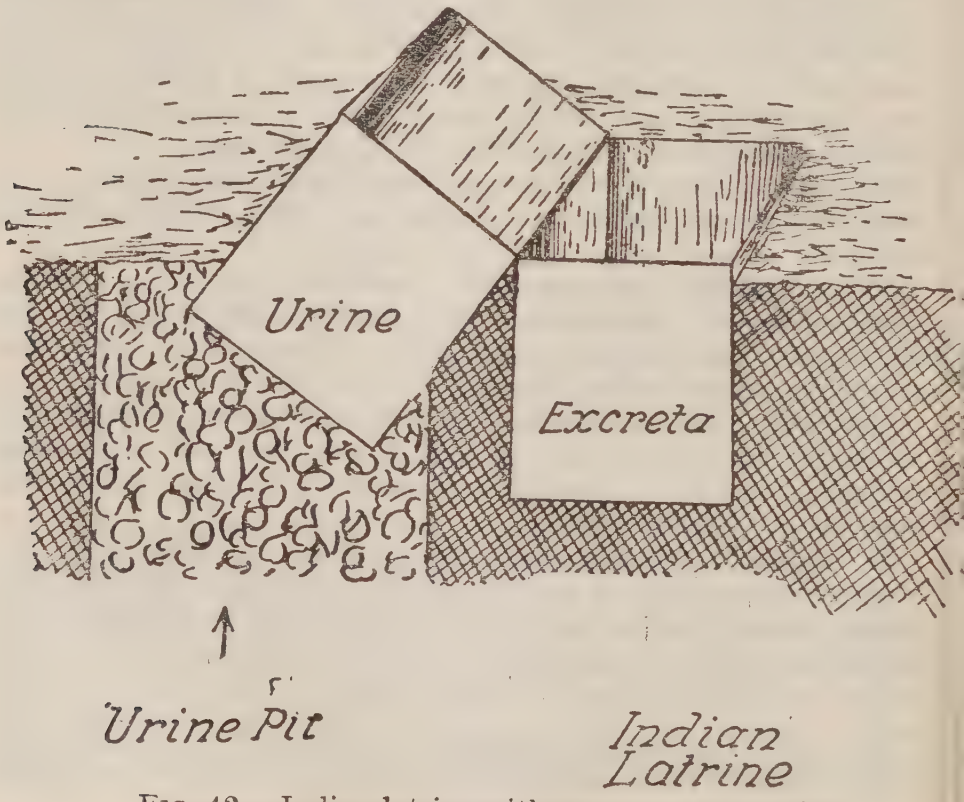


FIG. 42.—Indian latrine with separate receptacles.

An "abdust," or washing place, should always be placed near the latrine, as Indians do not use paper but wash themselves after using the latrine. Trenches lined with tin or heavily oiled should be constructed with a fall to a covered and fly-proof soakage pit (Fig. 43).

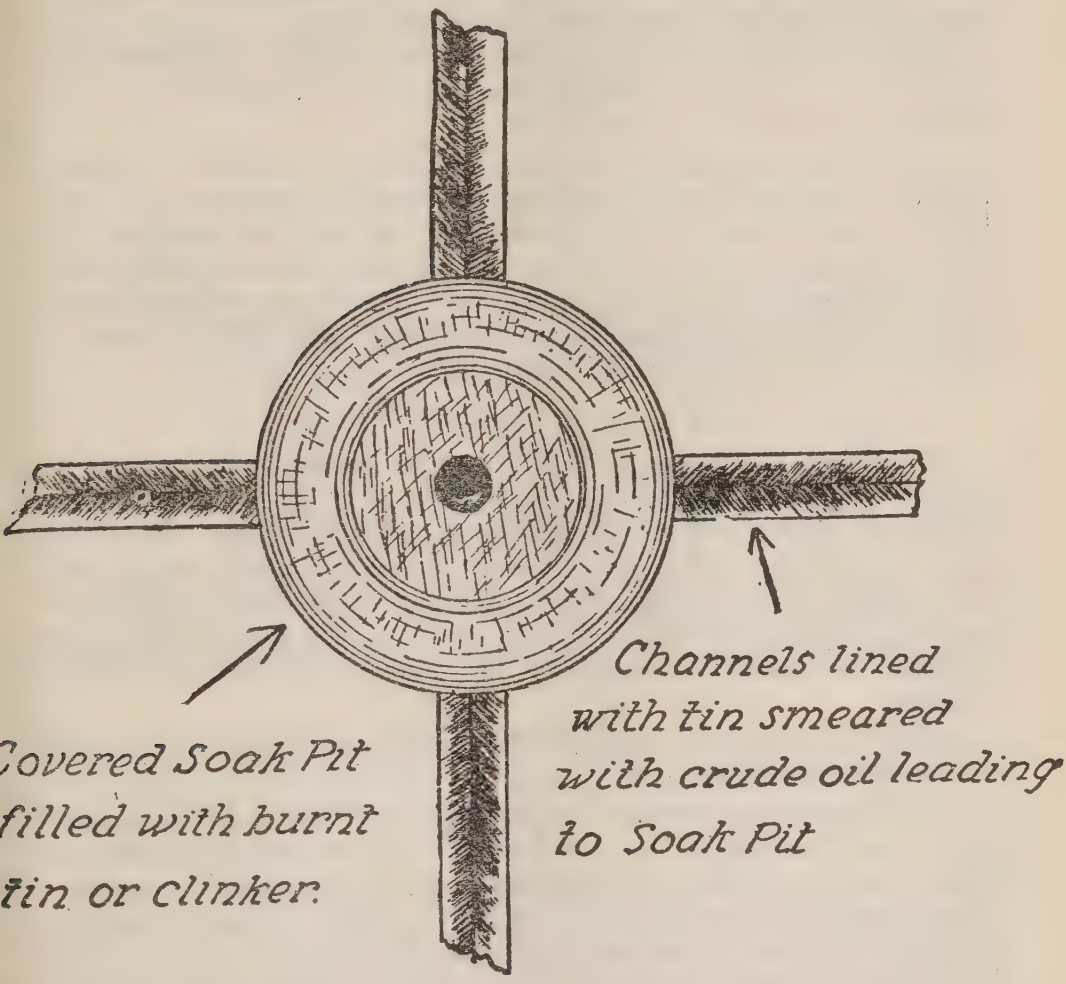


FIG. 43.—"Abdust" or washing place for Indian latrines.

181. The control of flies is always a serious problem in the East. They breed with great rapidity and swarm in native villages, passing from their filthy breeding and feeding grounds to settle on food and fruit, upon which they deposit any dangerous germs which they may have picked up on their unsavoury pilgrimage.

182. Typhoid fever and other intestinal diseases are prevalent in tropical stations and cases of small-pox are usually to be found amongst the native population. It is essential, therefore, that all troops proceeding to tropical stations be fully protected by inoculation against typhoid fever, and by vaccination against small-pox before embarkation.

CHAPTER VI

DISEASE VECTORS

183. It has already been explained (*see* para. 46) that, in the transmission of germs of disease from sick to healthy, animals, especially insects, play a very important part.

Animals which act in this manner are called "vectors" or "porters" of disease and their control and destruction is a necessary measure in prevention.

184. Measures against animal vectors of disease include (*a*) the abolition or treatment of breeding places, (*b*) the destruction of the vector as early in its life as possible, (*c*) the prevention of access of the vector to sources of infection, and (*d*) the protection of man and his surroundings from invasion by infected animals. No single measure is usually effective ; a combination of all four is necessary.

HOUSE FLIES.

185. It has been proved that flies can transmit the germs of typhoid and para-typhoid fevers, dysentery, cholera, epidemic diarrhœa, tuberculosis and infective conjunctivitis. Bacteria may be carried in the fly's intestine, being passed out in the excrement; in the crop, being regurgitated when the fly is feeding; or on the hairy feet of the insect, from which the bacteria are readily passed to the food upon which the fly alights.

Generally speaking, the plague of flies is worst in hot, dry and sandy countries.

186. The female house fly during her life of seven weeks lays about 500 eggs, in batches of 150 to 200. These are deposited in moist fermentable material—horse manure, camel dung, human fæces or ordinary refuse. Horse manure is the commonest site, but eggs are deposited in *fresh* moist material. Human fæces offer a suitable breeding ground, and over 3,000 larval forms have been found in one human deposit. The eggs are laid in cracks on the surface of whatever material is selected and hatch out very rapidly—in less than 24 hours—into small white maggots, which crawl about near the surface of the heap, and feed. In from two to five days these larvæ are fully grown and seek a dry spot either in the surface cracks, or more commonly in the dry earth at the base of the heap, where a pupa or grub is formed. These pupal forms may be found in the earth to a depth of 2 ft., and within a radius of 4 ft. from the manure heap (Fig. 44). They are little brown seed-like bodies, the outer case being made of the dried larval skin. Within this case complete disintegration and reconstruction takes place, and after two to eight days the

young fly—soft and with crumpled wings—emerges. These young flies, which are able to reach the surface through several feet of light sandy soil, may frequently be seen running about on manure heaps looking very like small spiders.

187. The fly will travel under normal conditions a few hundred yards, with a favouring breeze up to a mile, and upon men or camels it may cover great distances. Light is a great

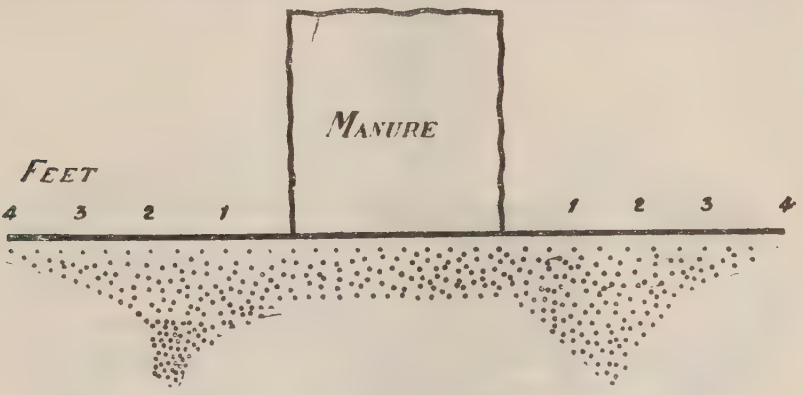


FIG. 44.—Distribution of fly pupae in soil around a heap of horse manure.

Diagrammatic section through heap of manure and subjacent soil to show the migration of the larvae of Musca Domestica. Distance and depth in feet being indicated. The black dots in soil represent Pupae.

attraction, and dark spots are avoided; the former attribute determines the design of many fly-traps, the latter is responsible for certain requirements in the structure of latrines and cook-houses.

188. Horse manure is so favourable a material for fly-breeding that its suitable disposal is a matter which demands constant attention, not only in tropical but also in temperate climates.

Horses should not be stabled or picketed close to billets or dwelling-huts, or near kitchens and dining-rooms in standing camps. Cleanliness of stables and horse lines, and the daily removal of horse droppings and manure must be ensured. When possible fresh sawdust should be used instead of litter. Picket lines should be burned over once a week.

The agricultural value of manure must never be overlooked, and whenever possible it should be utilised, provided that suitable arrangements can be made for regular removal and rapid and safe disposal.

Military conditions frequently preclude any possibility of such an arrangement, and in this case it is necessary to adopt one of the schemes outlined below.

189. All manure should be removed daily to some carefully selected site; if possible, at least $\frac{3}{4}$ mile from the camp. Removal may be carried out in G.S. wagons, or, where large quantities are involved, a light tramline should be provided. It is then dealt with by one of the following methods.

190. Manure may be burned in large four-way-trench (Fig. 45) or centre-cone incinerators (Fig. 46) or on a grid of

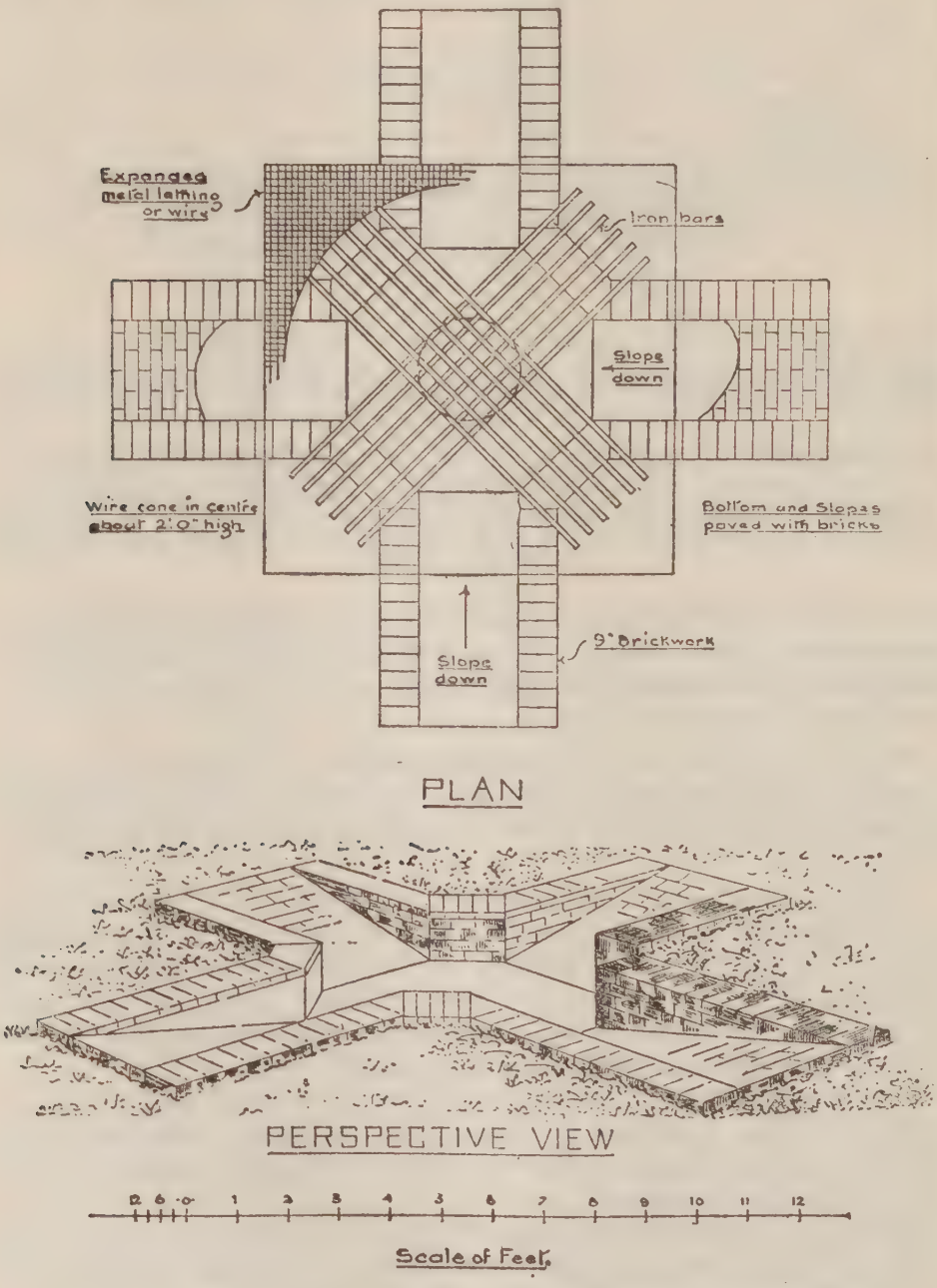


FIG. 45.—Four-way trench incinerator for horse manure.

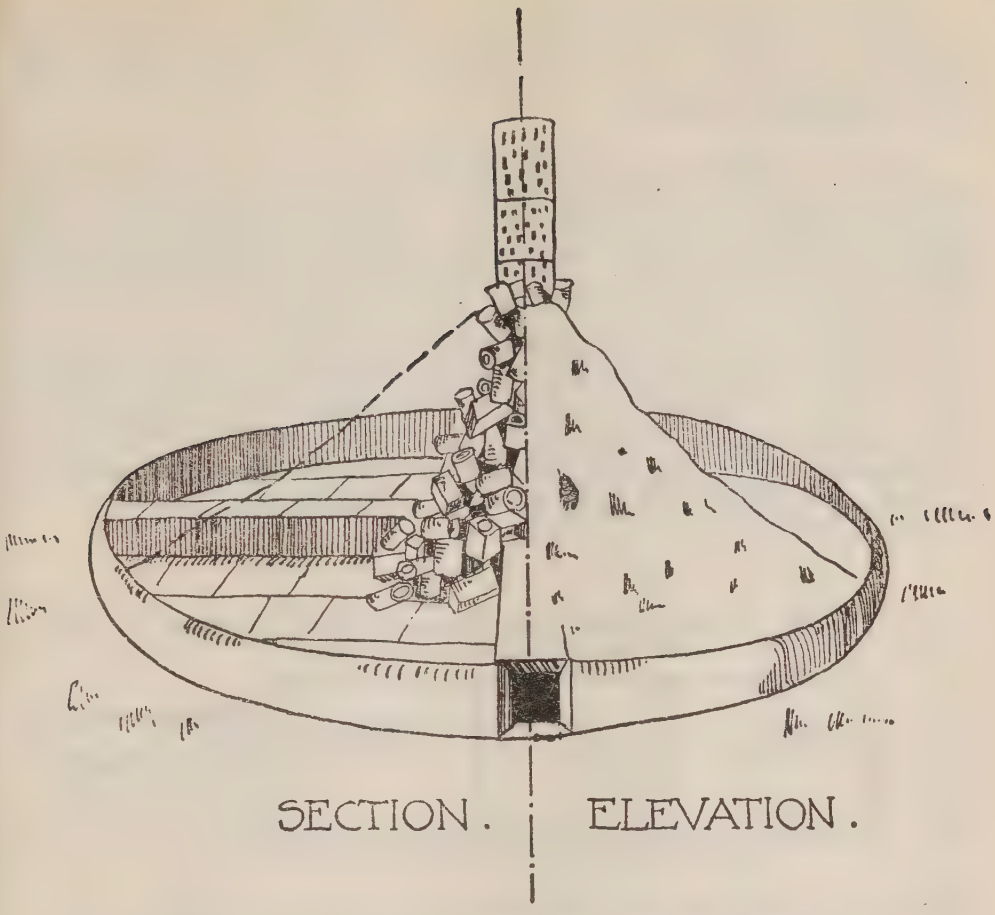


FIG. 46.—Centre-cone incinerator for horse manure.

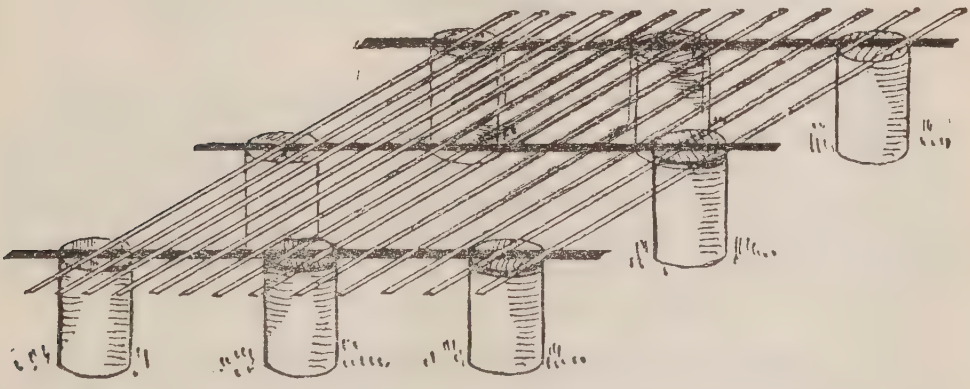
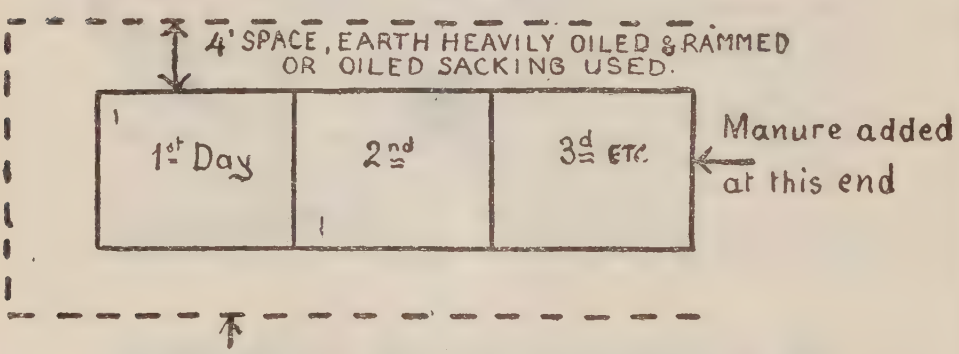


FIG. 47.—Grid incinerator for horse manure.

light tramlines raised on cresol drums or on brick supports (Fig. 47); a gridding 40 feet by 6 feet is required for each hundred animals.

In desert countries the quantity of sand mixed with manure renders it difficult to burn. It is necessary to sift as a preliminary measure, and all siftings should be sprayed with oil and buried deeply.

191. The method of tight packing is a very effective way of dealing with horse manure. A dump is made 10 ft. wide and 5 ft. high ; it is railed off on three sides so that the carts unload at one end only. The manure must be carefully stacked and tightly packed by beating with spades. As a result of this process such a temperature is generated in the heap that the larval forms either die or migrate to the surface, where the heat is less intense. To destroy any larval forms which may have escaped in this way, the stack should be stripped to a depth of 6 in. on the fourth day, and the stripped material buried to a depth of 3 ft in the heap (Fig. 48).



Barrier to prevent loading except at one end of heap.

FIG. 48.—Area for close packing of horse manure.

The base of such a manure heap needs much attention. The ground should be heavily oiled and beaten into a hard smooth surface extending over the area where the heap is to stand, and for 4 ft. beyond in every direction. Oiled sacking may also be used, folded in at the edges so that when the heap is completed the overlap may be pulled out and used to cover the sides of the heap as an effectual larva trap (Fig. 49).

192. A method of spraying manure dumps may be combined with tight packing and is very suitable for a large camp. Two dumps are established, being used on alternate days. At the completion of each day's work the heap for that day is levelled and sprayed with an emulsion of crude tar oil or green oil and soft soap, using 1 gallon for each square yard. In the neighbourhood of such dumps arsenite traps may be

placed. A solution of 1 per cent. sodium arsenite with 12 per cent. glycerine and 5 per cent. sugar has been found to be effective.

193. In very hot dry climates manure may be spread out and used for road making. Manure spread in a thin layer on the ground when exposed to hot sunlight rapidly dries and becomes unsuitable for fly breeding. The manure must be

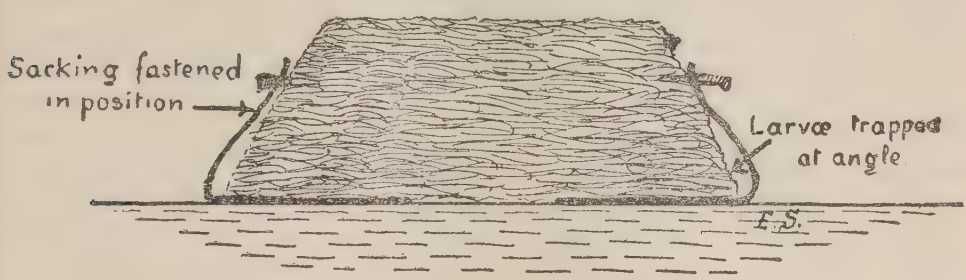


FIG. 49.—Use of oiled sacking in close packing of horse manure.

spread on the ground in a layer of from 1 to 2 in. thick. Four areas should be marked out, each of which will take one day's supply. The manure is spread, all lumps being broken up, and should be raked over daily. On the fifth day the first area is ready to receive another layer of manure.

194. Larval traps have been designed for use in manure heaps. Tins, with slits of a sufficient size to admit the fully-grown larval forms, are filled with chaff and sunk in the heap, so that the slits are just flush with the surface. The larval forms seeking a dry spot for pupation crawl into the tins and may be destroyed by burning the chaff. It is stated that 3,000 larval forms have been caught in one trap in 24 hours.

195. Latrines demand special care. They must be designed so as to be fly-proof (*see* paras. 129, 144, and 145) and, especially in the tropics, require constant attention to keep the wooden portions free from cracks and in good repair. In deep trench latrines fly-wires (*see* para. 198) may be suspended inside the box seats.

196. Camp refuse must be burned daily in a well-constructed incinerator (*see* para. 151). It is most important to see that there are no cracks or corners in which unburnt refuse can lodge, and to keep the ashpit clear, as flies have been found to breed in incinerators which are badly constructed and carelessly managed.

197. Measures for the destruction of adult flies must not be neglected, but they can only be regarded as secondary to those which aim at prevention of breeding.

198. Fly papers, tapes and wires are coated with a sticky material made from resin and castor oil (*see* Appendix V). Wires are hung up with a cork on the end to prevent dripping and, when covered with flies, may be cleaned by being passed through a flame and then re-coated. Fly papers catch best when placed in an arched position with the sticky side uppermost.

199. Fly-traps are very useful in hot countries. A trap should be well lighted so that after partaking of the bait the fly may be attracted into the upper part of the trap and remain there. Traps may be baited with jam, marmalade, milk and sugar, cheese and sugar, vinegar, bread and sugar, rum and treacle, or chicken's entrails. It is well to vary the bait and position of the trap from time to time, and the traps should be placed on the sunny side of cook-houses, &c., and sheltered from the wind. Each day's catch must be destroyed before dark.

Many forms of trap have been invented, but the principle of construction (Fig. 50) is the same in all cases.

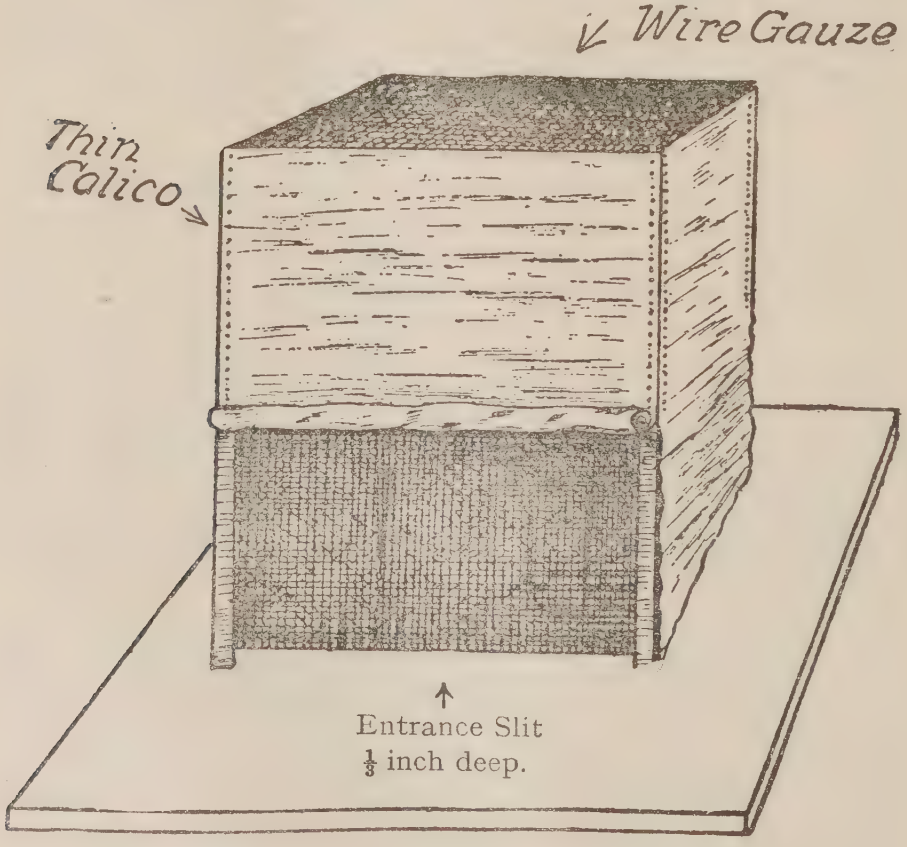


FIG. 50.—Construction of a fly trap.

200. Fly poisons are also useful, and for general use the best poison is a solution (*see* Appendix V) containing formalin. The mixture may be placed in saucers (with an island of bread on which the flies may alight) around the room or may be used in a bottle with a cap of blotting paper from which a wick of blotting paper hangs down into the liquid. All other liquids must be rigorously excluded.

Arsenical solutions (*see* Appendix V) may be used, sprayed on small leafy branches, which are hung up in latrines, &c., or in the ingenious roller-towel apparatus (Fig. 51). It has

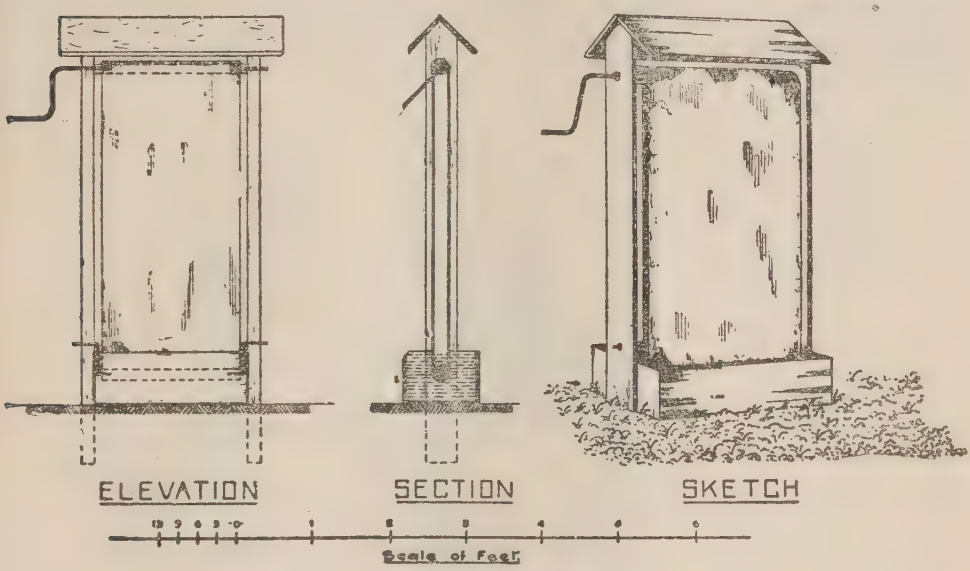


FIG. 51.—Roller Towel Pattern Fly-trap.

the grave disadvantage of being a deadly poison to man and, therefore, should be employed only under medical supervision and never in kitchens, messes, food-stores, &c.

201. Fly sprays may be used with success where flies congregate in the evening, especially in huts, tents and stores (*see* Appendix V). As the flies are not killed they should be collected and burnt before they recover. Crude kerosene or 5 per cent. cresol may be used in the open.

202. Large numbers of flies may be destroyed by "swatting," and ten minutes' work before each meal will practically rid a dining-room or mess-room of flies for the period of the meal.

203. In spite of the most active measures a certain number of flies will always be present, and the protection of food from flies requires strict attention and discipline.

Cook-houses should be kept dark, cool and open; they should not be fly-proofed. Blue glass in the windows is said to render an interior less attractive to flies.

In mess-rooms and dining-rooms fly-proof cupboards must be provided for food storage and wire gauze covers for food on tables; squares of gauze, weighted by beads, afford protection for food in jugs or bowls, but their repair and cleanliness require constant supervision; when the table is being laid, cups should be inverted in the saucers.

204. Fly-proof larders and food stores are essential, and must be kept in proper repair. There are many types from large cupboards with self-closing doors to the simplest form improvised from two rings of wire and a piece of netting (Fig. 52).

FIG. 52.—Improvised fly-proof larder.

In hot climates underground or dug-out larders, if properly fly-proofed, are of value in keeping meat under cool conditions (Fig. 53).

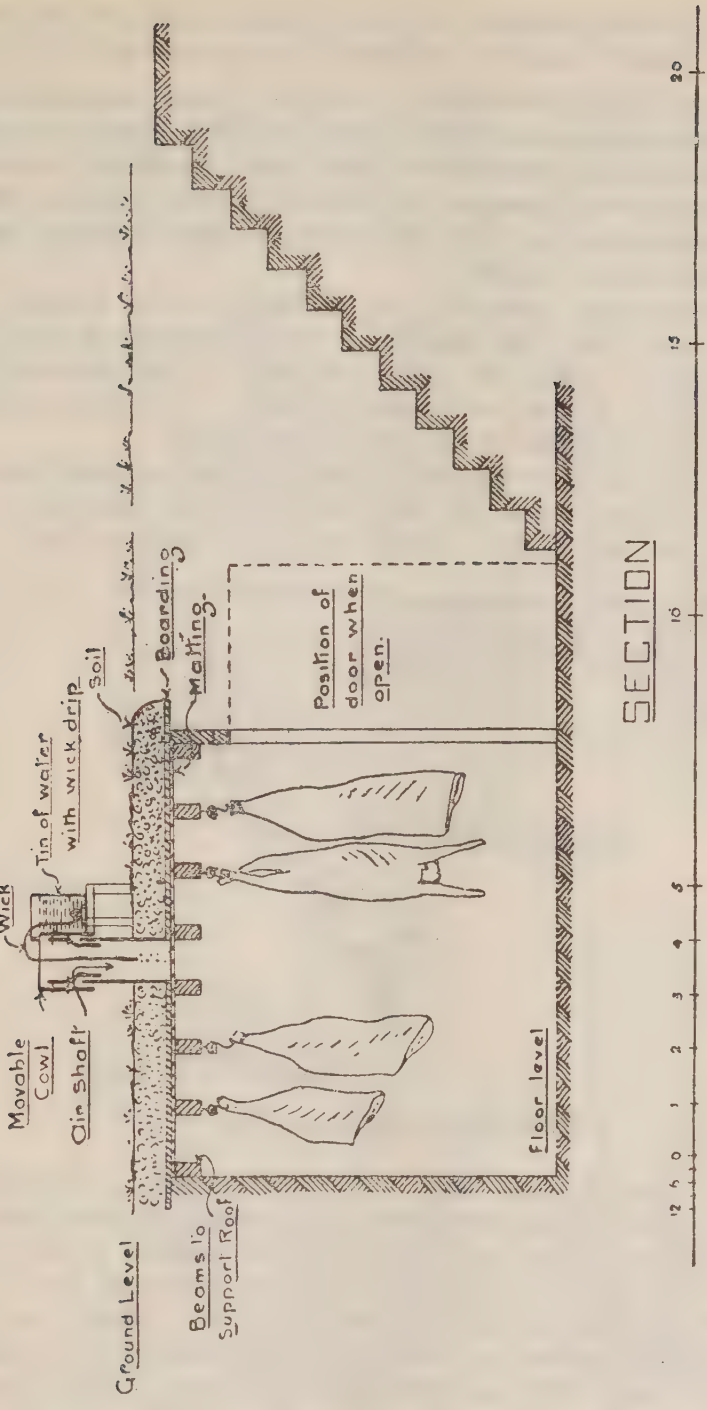


FIG. 53.—Dug-out Meat Safe.

MOSQUITOES.

205. Mosquitoes spread the germs of malaria, yellow fever, dengue, and other diseases and, in fact, represent the only means by which these diseases can be conveyed to healthy persons. Malaria is spread by certain mosquitoes known as *Anophelini*; yellow fever is conveyed by a mosquito

known as *Aedes argenteus* (*Stegomyia fasciata*), a species of the *Culicini*, other culicines are also disease carriers.

206. The mosquito breeds in water, more especially in shallow water overgrown with weeds: it may breed in ponds and streams, marshes, shallow collections in large leaves or hollows at the foot of trees, or in domestic collections in water tubs, broken guttering, tins thrown on the rubbish heap, or abandoned water troughs.

The eggs are very minute, just visible to the naked eye. *Anopheline* eggs are laid singly or in star-shaped clusters; they have floats. *Culicine* eggs are laid in clusters forming a small raft with a concave upper surface. The colour of the eggs varies from a light brown to a deep black.

The larval forms are aquatic, feeding upon minute animal and vegetable particles in the water, and breathing air through the surface film. They are about half an inch long

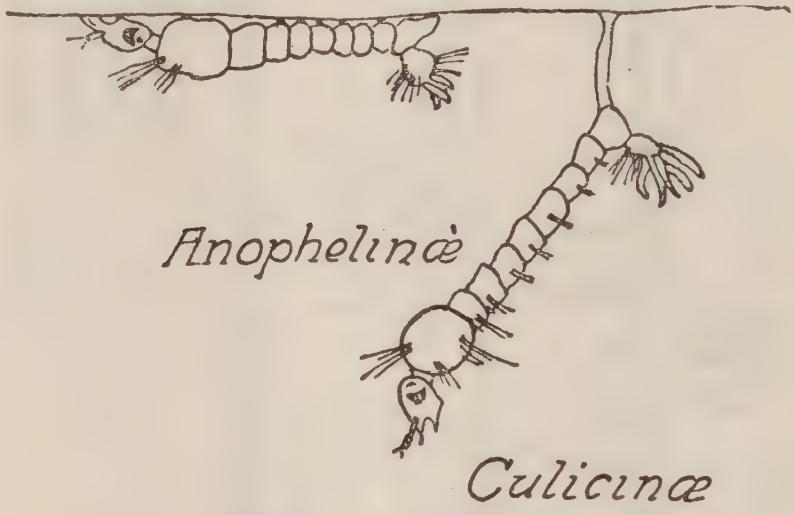


Fig. 54.—Mosquito larvæ.

when fully grown, and are very active; the *Anophelines* progress by darting, and the *Culicines* by wriggling movements. The *Anopheline* larvæ lie parallel to the surface of the water like small pieces of stick, and breathe through two small papillæ on the eighth abdominal segment. They are suspended from the surface of the water by palmate or expanded hairs placed on the abdominal segments. The *Culicine* larvæ possess a larger head and hang away from the surface of the water, being suspended by a prominent syphon or breathing tube on the eighth abdominal segment (Fig. 54). As the larval stage lasts from 7 to 10 days, pools that are too large to drain should be oiled at least once a week.

The pupal forms have the head and thorax enclosed in a sack-like structure, and breathe through syphons in the

thoracic or chest region. This stage is a short one—two or three days—and differentiation is immaterial.

207. In dealing with the imago or adult it is important, in the first place, to ascertain the sex, as the female alone sucks blood, the male being a harmless vegetarian.

The insect must be held in such a way that the head appendages can be clearly seen (Fig. 55). First the central and

FIG. 55.—Head appendages of mosquitoes.

conspicuous proboscis should be identified in both the *Anophelinæ* and *Culicinæ*; this is practically straight. The outermost appendages are the antennæ; if these are heavily plumed the specimen is a male. Between the proboscis and antennæ are paired appendages known as the palps.

These are as long or longer than the proboscis in the males of both *Culicines* and *Anophelines*, but in the female there is a marked difference, the female *Culicine* having short stumpy palps which are just visible, whilst the female *Anopheline* has palps of practically the same length as the proboscis. The majority of *Anophelines* have spotted wings, but this is by no means universal.

The resting attitude is also of value as a distinction, *Culicines* resting parallel to the surface, while *Anophelines* appear to "stand on their heads" (Fig. 56); but all *Anophelines* do not assume this position.

Position of Anopheles Mosquito. **Position of Culex Mosquito.**

FIG. 56.—Resting attitudes of mosquitoes.

208. During the day *Anophelines* tend to leave houses and rooms and seek the shelter of bushes and jungle outside, but usually near dwellings. Often, however, they will be found during the day hiding in the dark corners of tents or shelters, or in clothing hung on walls and in cupboards.

209. The treatment of mosquito breeding areas is skilled work requiring considerable experience and training, but a general knowledge of the necessary measures should be possessed by all. Marshes are drained, streams are canalized and weeds removed, small pools are filled in with stones and soil, watering places are paved to prevent hoof prints in the mud, covered tanks and reservoirs have all openings screened by wire or cotton netting, small tanks, horse-troughs, &c., may be emptied and fully dried once a week.

Even the smallest collection of water may afford facilities for the breeding of certain mosquitoes; therefore gutters and drains must be kept dry, and old tins, &c., in which water may collect, must not be allowed to lie around.

210. Larvæ may be destroyed by oiling the water surface of breeding places once a week (Appendix V), or poisons, such as cresol, may be used. Goldfish, mullet and certain other small fish devour larvæ and are used for their destruction in tanks and other suitable collections of water.

211. Adult forms may be destroyed by fumigation (Appendix V), the stupefied mosquitoes being swept up and burned. Daily search must be made for mosquitoes resting during the daytime in dark recesses, hanging clothing, &c. (*see* para. 208), using "swatters" to kill any that may be found. The whitewashing of dug-outs, barns, dark portions of billets, &c., assists detection of the resting insects.

212. Camps and bivouacs should be sited away from possible mosquito breeding areas, and the villages and quarters of natives, amongst whom infection is usually widespread, must be avoided.

213. Huts and barrack-rooms, and all rooms in which men sleep or habitually assemble after sun-down, should be proofed against mosquitoes (Fig. 57), and the use of a good

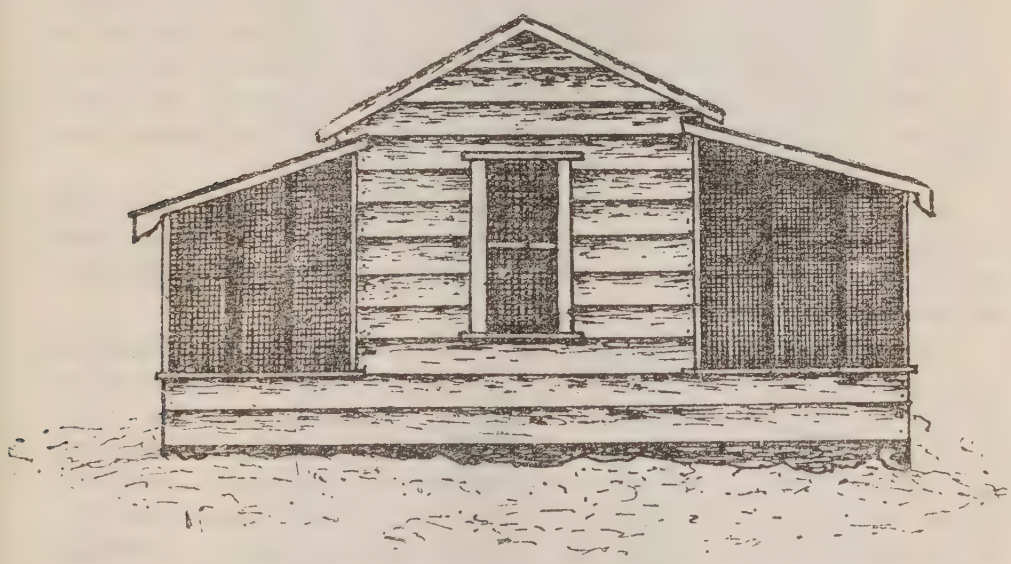


FIG. 57.—Mosquito-proof hut with verandah. Wire gauze of tinned iron, copper, or brass for windows, verandahs, etc. Double self-closing doors.

individual mosquito net is essential. Nets must be kept in good repair and properly used; in bed the net must be tucked in below the mattress all round; on no account must it touch the user at any point, and it should be searched for any contained mosquitoes before one goes to bed.

For use in camps, bivouacs, and under active service conditions bivouac mosquito nets (Fig. 58, page 89) are provided (*see* Appendix VI). Their efficiency depends entirely upon the manner in which they are used and the care taken to keep them in good repair; these matters must receive constant and detailed attention from regimental officers.

214. Veils and gauntlets are supplied for men, *e.g.*, sentries, patrols, outposts, &c., whose duties prevent them from keeping under cover (Fig. 59). On no account should shorts be worn after sundown, but special shorts (Fig. 59) with knee-flaps, which can be turned down and tucked under the upper turn of the puttee, should be provided.

215. Various greasy preparations or ointments (Appendix V) can be smeared over the face, hands, arms and other exposed parts of the body, when the use of nets or protective clothing may be impracticable; but it must be remembered that such measures have only a very transitory value; the oily application is easily rubbed off, and the false sense of security may lead to a dangerous relaxation of other and more effective precautions.

PHLEBOTOMI.

216. These are minute flies, commonly, though wrongly, called "sand flies," whose bite gives rise to much irritation and whose small size enables them to creep through the mesh of ordinary mosquito nets. They are the agents by which the germ of phlebotomus fever (*see* para. 281) is spread from man to man.

217. These insects breed in such places as damp and dark cellars, dug-outs, cracks and fissures in soil or in damp stone walls, in tunnels, caves, etc.; rotting refuse or vegetation is required as food.

218. These breeding places should be attacked by rendering the ground surface level and impermeable, repairing all cracks and holes in walls by facing, pointing, tarring, etc., by strict attention to the cleanliness of surface drains and gully traps, and by keeping the ground at the junction of walls of buildings free from debris and dust. The lower three feet of exterior walls of buildings should be tarred annually before the commencement of the hot weather, and the interior of all rooms painted or limewashed.

The ground surface around living and sleeping quarters for a distance of 20 feet may be covered with concrete, or sprayed with tar, and once weekly all broken ground within 50 yards should be sprinkled with crude oil.

219. To prevent entrance of flies into rooms, any ill-fitting window frames, doors, ventilators must be repaired, ventilators must be kept free from dirt; they may be smeared

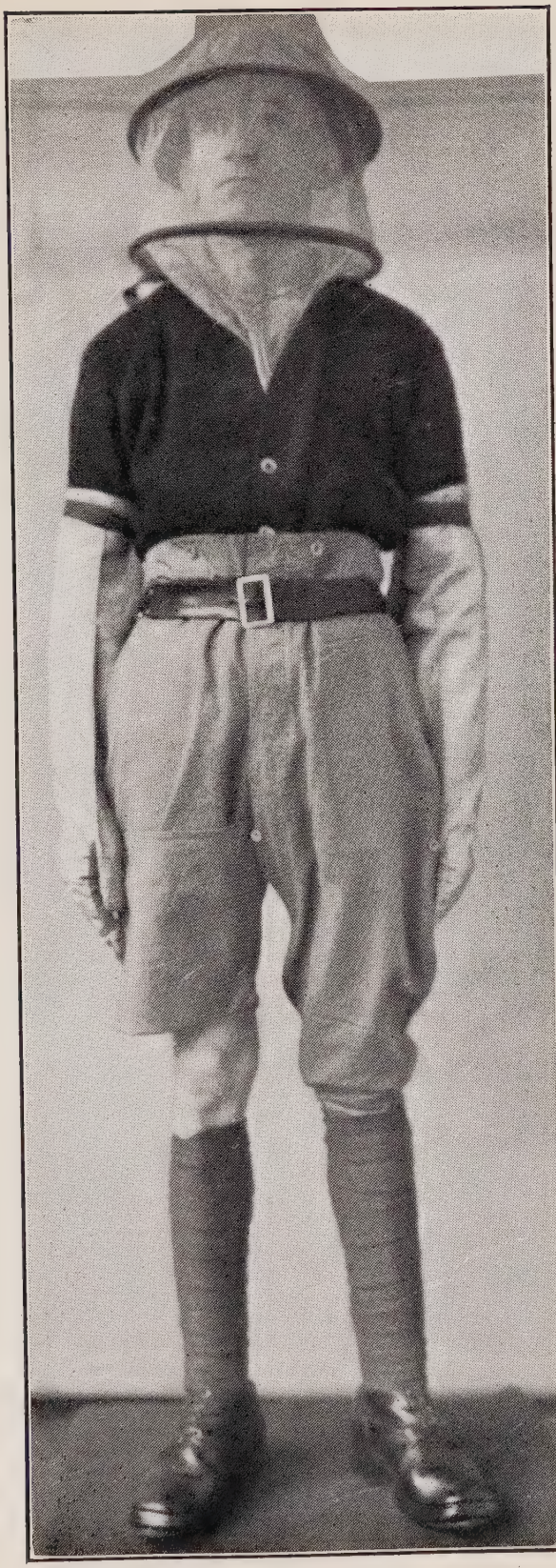


FIG. 59.—Anti-mosquito clothing (head-net, gauntlets, and special shorts) as worn.

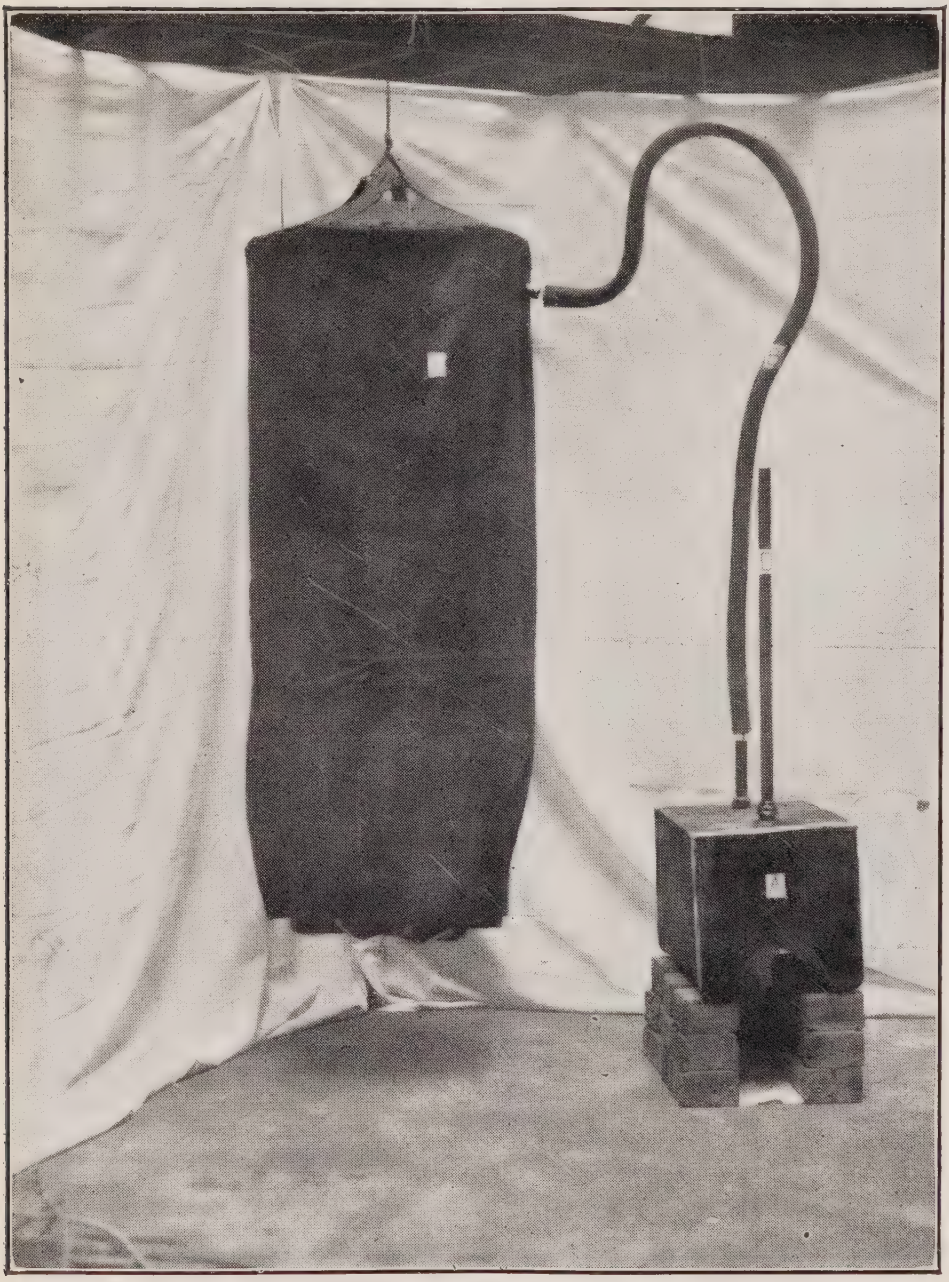


FIG. 61.—Sack Steam Disinfector. (Downward displacement current steam.)

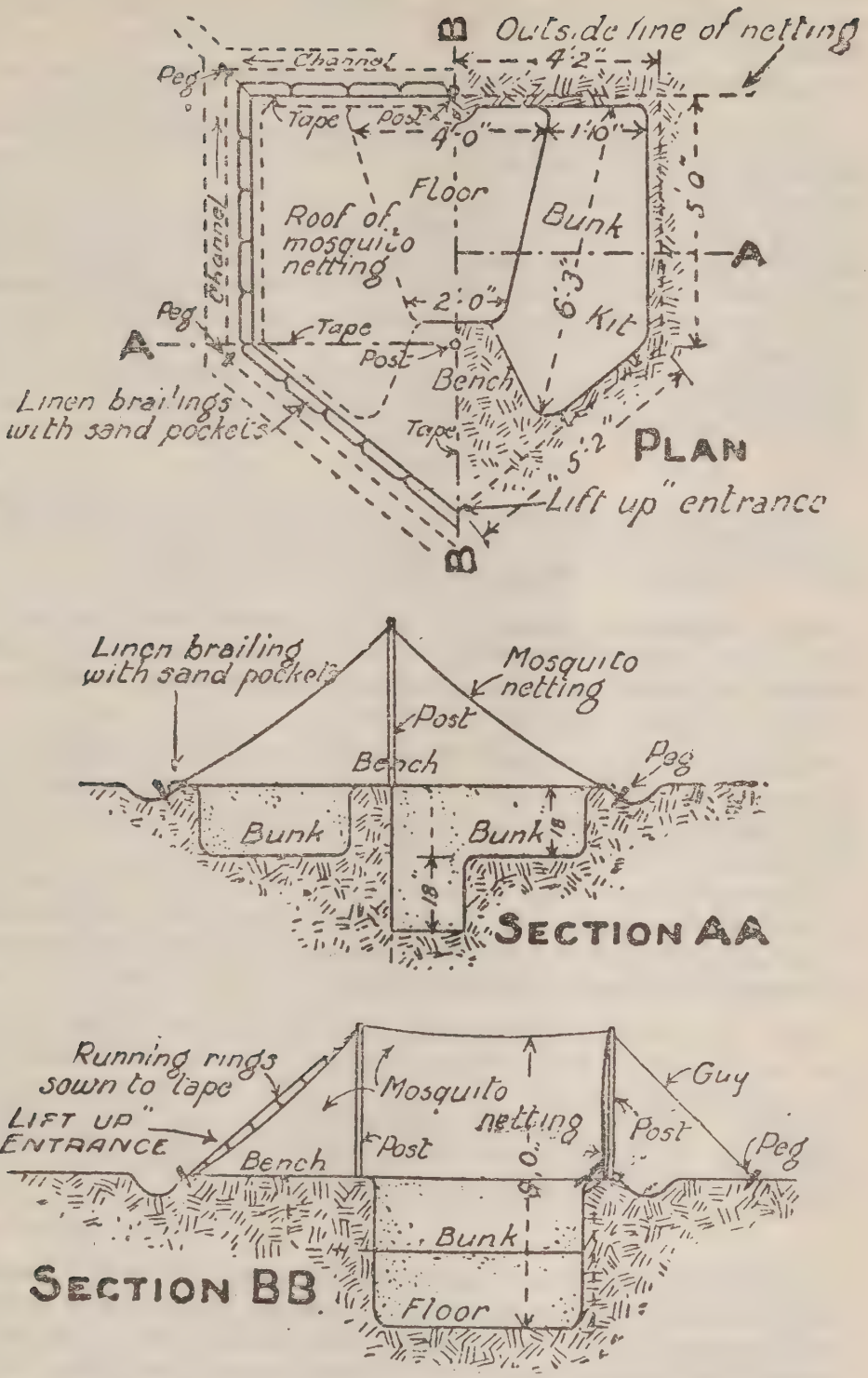


FIG. 58.—Method of using Bivouac Mosquito Net.

with paraffin oil. Ventilation must be free and a liberal supply of fans or punkahs is desirable, as these insects dislike moving air.

Special nets of fine mesh (*see* Appendix VI) may be provided.

220. During the day these flies seek refuge behind clothing hung up or folded on shelves, in the corners of huts, and behind dust and cobwebs.

Each day, therefore, the hut or room must be thoroughly cleaned, especially in the corners, all kit and clothing shaken and dusted, and all dust and cobwebs removed, all flies being killed by swatting or spraying with a one per cent. solution of cresol.

Once weekly the whole of the interior of the room or hut should be sprayed with a similar solution of cresol.

FLEAS.

221. Fleas are the means by which plague (*see* para. 283) is transmitted from rats to man, the bites being infected by germs regurgitated from the stomach of the flea.

222. Eggs laid by fleas fall to the ground and later hatch out larvæ, which live and feed on dust and on debris in the corners of rooms beneath carpets, and in cracks or holes in the floors and lower parts of the walls.

223. No dust or debris, therefore, should be allowed to gather in rooms or huts. The floors may be dusted with powdered naphthaline or scrubbed with an emulsion (*see* Appendix V) of soft soap and paraffin.

Infested houses may be fumigated with cresol vapour (*see* Appendix V), all dust being afterwards swept up and burned.

Domestic animals and pets must be kept scrupulously clean and free from infestation by fleas.

224. To protect individuals from attack, powdered naphthaline, iodoform (very objectionable on account of its smell) or pyrethrum powder (Keating's) may be applied to the clothing. A bed may be protected by a zone of fly-papers round it, some thirteen inches wide, and the use of bed-spreads washed with paraffin is often effective.

RATS.

225. From the point of view of disease causation, two species of rat are recognised as important. These are, firstly, the black rat, which is normally a domestic rat, a tenant of houses and seldom found far from human habitations, and, secondly, the brown rat, larger than the black rat and an inhabitant of farm buildings and stack-yards, drains and sewers, country ditches or even open land.

Both species are implicated in the spread of plague (*see* para. 283), which is primarily a disease of rats and is transmitted from the rat to man through the agency of the rat flea; but the brown rat, being less closely associated with human beings, is less frequently proved guilty.

Other diseases are also due to rats. A severe, sometimes epidemic, form of jaundice (*see* para. 260) is due to contamination of food or water by the brown rat, in whose excreta the germ of the disease is found, while it has recently been proved that a definite infectious fever (Rat-bite fever) may follow the bite of a rat.

226. The best methods of exterminating rats are trapping and poisoning and, whatever methods be adopted, the attack must be conducted throughout the whole garrison or cantonments at one time, and, if possible, with the co-operation of the civil authorities for a simultaneous campaign outside barracks.

In regard to trapping, traps should be slightly oiled to prevent rusting, handled with gloved hands, and care taken to avoid contamination with human odour.

Poisons (*see* Appendix V) may be spread on pieces of bread, fresh vegetables (tomatoes are a useful bait) or grain. Care must be taken that these baits are not picked up by children or domestic animals.

For the destruction of rats on board ship special methods are used, under medical supervision.

Care must be taken in handling dead rats during plague epidemics, or in countries where plague is prevalent. All dead rats should be destroyed by burning.

227. All food must be protected from the access of rats; this is of special importance in dug-outs and trenches. General cleanliness with proper disposal of refuse, especially scraps of food, is essential.

LICE.

228. Typhus fever, relapsing fever and trench fever are spread from man to man by the agency of lice. Lice also cause great skin irritation and the entrance of germs into their bites or abrasions due to scratching may cause inflammatory conditions of the skin.

229. These insects infest clothing, especially under-clothing, the hair of the head, and any hairy region of the body. Their eggs (nits) are laid in the same situations, each egg being firmly cemented (Fig. 60, page 92) to a hair or a clothing fibre.

Lice do not willingly leave their human host, they (or their eggs) are seldom found on greatcoats or blankets, and the so-called "lousy" hut or tent or dug-out in practice does

FIG. 60.—Egg of louse to shew fixation to hair.

not exist, though lice from lousy individuals may accidentally be present and can survive for several days. Man himself is the sole breeder and distributor of these parasites.

230. The best way to kill lice and nits on infested clothing is by exposure to heat.

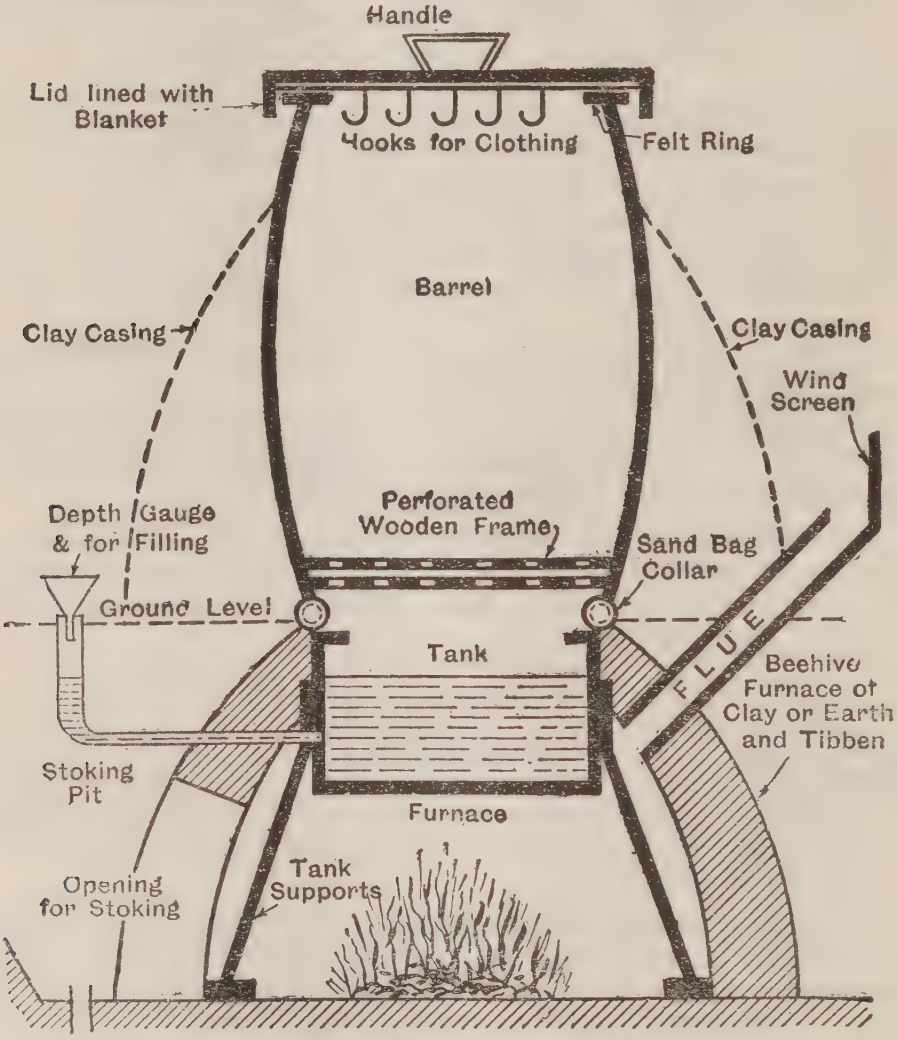


FIG. 62.—Serbian barrel disinfestor (upward displacement current steam).

Steam disinfection is most efficient and can be applied in various types of disinfector. The "sack disinfector" (Fig. 61, page 89) is a compact, portable and reliable type. It consists of a boiler heated by an oil burner or (in emergency) by an open fire, a flexible hose pipe conveying steam from the boiler to the closed end of the sack, and a sack in which the clothing is packed. The sack is then inverted and hung up so that steam enters at the upper end and disinfection is completed after steam has issued freely from the lower end (the mouth) of the sack for two minutes.

231. An improvised form of disinfector is the "Serbian Barrel" (Fig. 62). Steam from a boiler, heated by a fire, passes upwards into a barrel through holes made in the bottom. The clothing is placed in the barrel or may be suspended from

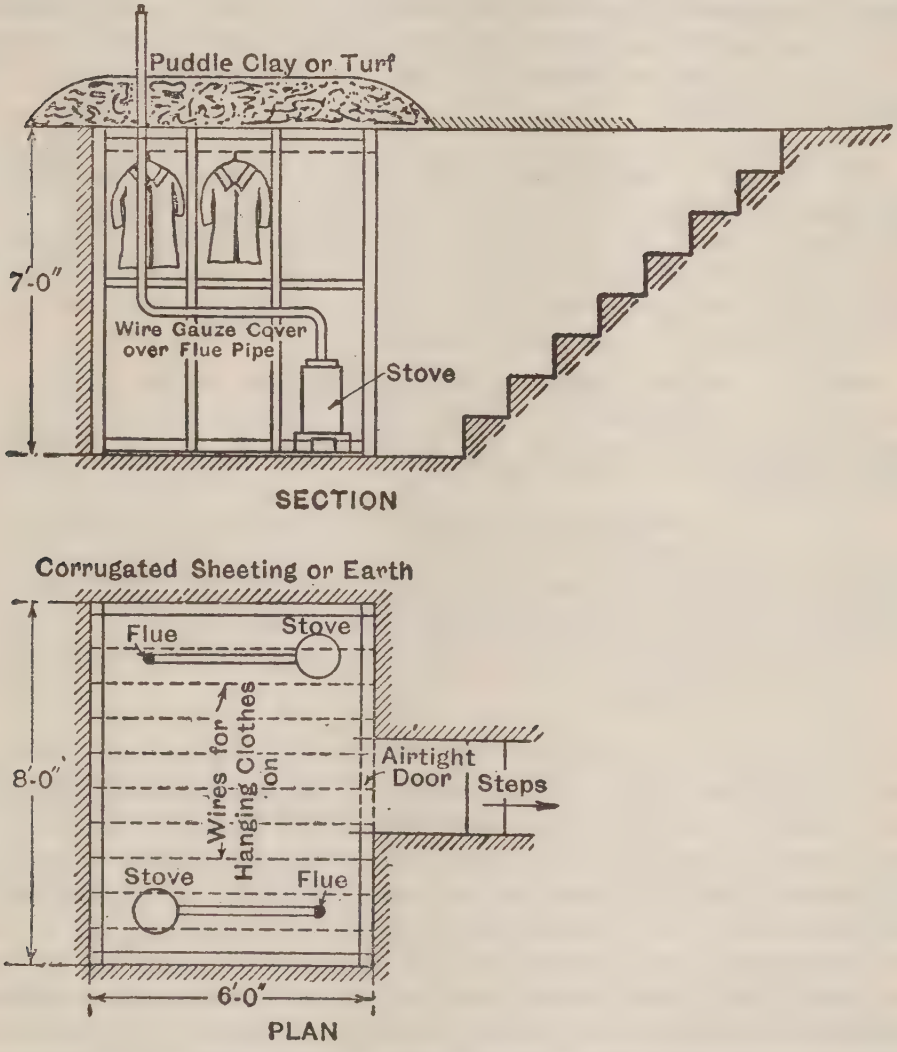


FIG. 63.—Russian Pit for Hot Air Disinfestation. Suitable for Woollens, Furs, &c.

hooks fixed in the lid and is exposed to the steam for from thirty to forty minutes. It is essential that the boiler be fairly large and the best results are got when the water surface is equal to the base of the barrel. Where it is not possible to construct a water-tight joint between the boiler and the filler, the boiler must be filled from the barrel, the depth of water being ascertained by means of a stick.

232. Dry heat may be used to kill lice and nits, a temperature of 70 degrees C. (158 degrees F.) being maintained for half-an-hour. Note that this temperature must be registered inside the clothing, not merely in the chamber. This apparatus can be very easily improvised in the field (Fig. 63, page 93). Dry heat penetrates very slowly; the garments, therefore, must be hung up loosely, not bundled nor thrown on the floor of the chamber. Articles of clothing will be scorched or burned if they are allowed to touch the brazier or flue.

233. Lice on the body may be killed by the use of a mixture of equal parts of paraffin and olive oil. Wet the hair thoroughly with this mixture, bandage overnight, and wash with soap and warm water next morning. Paraffin alone or turpentine may be used in the same manner, but are more irritating than the olive oil mixture.

Another method consists in taking one ounce of N.C.I. powder (*see* Appendix V), wrapping it up in a fold of the shirt and turning in, wearing all underclothing, under blankets for the night.

Nits may be removed from hair by the use of a fine tooth-comb ; the previous application of dilute vinegar (1 part vinegar and 9 parts water) assists removal by softening the cement by which the nits are fastened to the hairs.

The hair should be shaved from the parts (except the head) of the body infested.

234. Ideal conditions for the spread of lice from man to man are found in overcrowding, lack of facilities for ablution and bathing, and the necessity for living in the same clothes night and day. Regular bathing, provision of clean under-clothing, and disinfection of outer clothing and discarded underclothing will do much to lessen the danger.

The periodical issue of N.C.I. powder for dusting on the underclothing is of value, and both body and underclothing should be searched regularly for any evidence of infestation. Responsibility for the inspection of their men as to personal cleanliness and freedom from vermin lies, in the first instance, upon regimental officers.

235. Although there is no definite proof that these insects are concerned in the spread of infectious diseases, their presence may cause serious discomfort and interference with sleep.

They live in cracks in floors, walls and furniture, or in the joints of beds, or among the folds of blankets or under the mattress, whence they emerge at night to feed.

236. Once bugs have obtained a footing, they are very difficult to eradicate. Certain methods of fumigation, which must be carried out under medical supervision, are the only effective means of destruction in a house or hut.

237. Preventive measures are the filling up of all cracks in the floor and walls, frequent scrubbing of floors with hot water or dusting with powdered naphthaline, and attention to general cleanliness.

Standing the feet of the bed in saucers containing paraffin is a useful measure, provided that the bed itself does not harbour these pests.

The use of a bedspread washed in paraffin is a useful deterrent.

CHAPTER VII

SHORT NOTES ON SOME IMPORTANT DISEASES

Typhoid (Enteric) Fever.

238. Typhoid or enteric fever is one of the most important diseases affecting soldiers in the field, and in the absence of suitable precautions no force of any size is likely to remain free from it.

It affects armies, especially on service or in hot climates, and is rife in beleaguered towns, on account of the difficulty of disposing of refuse and excreta, and of securing the protection of food and water from contamination.

239. It is caused by a germ called the typhoid bacillus, which enters the body by the mouth, usually in food or water, and after an interval of from 8 to 21 days (the "incubation period") the disease comes on, as a rule, gradually, shewing itself by continued fever, great weakness, and frequently by diarrhœa. Ulceration of the bowels is its distinguishing feature. It lasts from 3 to 5 weeks and relapses are not uncommon: one attack does not absolutely protect from another.

240. Typhoid germs are found in large numbers in the stools and urine of the patients during the disease and even when convalescent, while some cases ("carriers") continue to pass these germs for years after recovering from the disease and while in apparently perfect health.

It is an ascertained fact that, during epidemics of typhoid fever, persons who are apparently quite well may be the bearers of typhoid bacilli, and be passing excreta full of infective germs.

Also, during epidemics, mild attacks occur, so mild that the men do not feel ill enough to report sick, but are, nevertheless, disseminating typhoid bacilli. It is therefore most important during an epidemic that any man who is indisposed, especially if he has diarrhœa, should at once report sick.

241. Typhoid fever is usually spread by means of food or water which has been handled by men who are suffering from the disease or who are "carriers." Hence it is a rule that no man who has suffered from typhoid fever is allowed to be employed as a cook or on any duty which involves the handling of food or drinking water.

242. The germ of typhoid fever is one of the germs of disease which can live in such things as food, water, soil, clothing, &c., for a considerable time after leaving the body of a patient or "carrier."

Typhoid fever may, therefore, be spread by drinking vessels or other articles which have been used by men suffering from the disease.

Blankets, bedding and clothing used by the sick are also likely to infect those using them before they have been disinfected.

The germs are frequently conveyed by the hands; it is important to wash the hands, paying special attention to the finger nails before preparing or taking food.

Epidemics have been caused by vessels, which were washed in water infected with typhoid fever germs, being used for food or drink.

Uncooked vegetables, such as lettuce, watercress, &c., which have been watered or washed with water containing germs, have caused the disease. Oysters and other shell fish, kept in contaminated water or fished from beds where the water is contaminated with sewage, also cause epidemics of typhoid fever.

No food or drink the history of which is unknown should be taken without being first cooked or sufficiently heated to destroy any germs.

Raw vegetables and drinks sold by hawkers must be avoided. Fresh milk is specially liable to contamination as

it is a suitable soil for the growth of germs; in foreign stations it should invariably be boiled or sterilized before issue.

Water is one of the means by which typhoid fever is disseminated. Therefore no water should be used by troops for drinking or cooking the source and quality of which have not been scrutinized and approved by the sanitary officer; occasionally, one cannot avoid collecting water from casual sources, as on outpost duty, or on the line of march, and in such cases it must be made safe by one of the methods described in Chapter IV. On active service all water should receive appropriate treatment.

The germs of typhoid fever are also spread by flies (*see* para. 46), and the destruction of flies (*see* paras. 188 to 202) is an important measure of prevention.

243. Experience, especially during the Great War, has shewn that anti-typhoid inoculation (*see* paras. 51 and 182) affords the greatest protection to the soldier against attacks of typhoid fever (Fig. 64, page 98); especially is this true of the young soldier proceeding abroad for the first time.

Paratyphoid Fevers.

244. These are diseases closely allied to typhoid fever, spread in a similar manner, and requiring the same measures (including inoculation) for their prevention.

DYSENTERY.

245. This disease has been prevalent in all wars and has caused great losses to armies. In British history there are some notable examples of this—in the army of Henry V before the battle of Agincourt, in the Walcheren expedition, and in the Crimean war.

Recently, owing to better food and sanitation generally, this disease has decreased in civilized armies, but under active service conditions it is a constant danger, and neglect of hygienic care would very soon lead to its proving as disastrous as in former times. In the South African Campaign it caused 31,000 admissions to hospital, and during the Great War it was a serious cause of inefficiency, especially in the Eastern war areas.

246. There are two forms of dysentery, the one due to a bacillus, and the other to an amœba, but the symptoms of these two forms are similar.

The period of incubation is from 24 hours to 8 days.

The disease comes on suddenly as a rule, the symptoms being pain in the bowels, a constant desire to go to stool, severe straining, and passing of slime and blood and, later on, of shreddy matter. It is, in fact, an inflammation and ulceration of the large intestine. In favourable cases it remains acute for about a week.

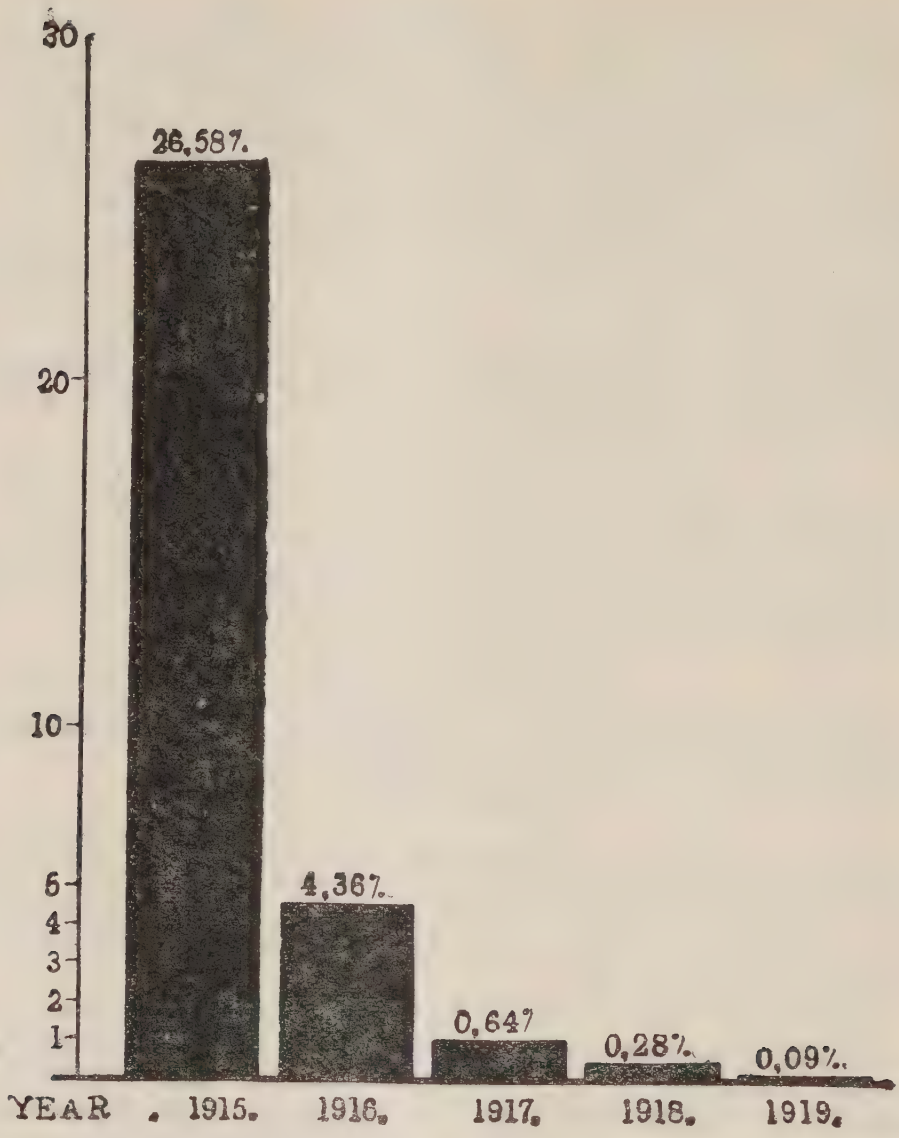


FIG. 64.—Incidence of Enterica in the French Army shewing rapid decrease as preventive inoculation became effective.

One attack does not protect from another, and men who have suffered from dysentery may continue to pass the germs of the disease in their excreta ("carriers") in the same manner as after an attack of typhoid fever.

247. The spread of infection in dysentery resembles that of typhoid fever, the germs being taken into the mouth with food, liquids and dust. They are passed out of the body in the fæces.

Contaminated water is one of the chief agents in spreading the disease, but food and dust may also convey it.

It may be acquired by eating food which has been handled by people with infected hands or which has been placed on contaminated plates, tables or tent floors.

It is not known exactly how long the organisms which cause dysentery will live outside the human body, but they may live for a short time in soil contaminated with excreta, and also in water and other fluids.

Blankets and clothing used by the sick may possibly convey the germ to others who may use them.

Flies carry dysentery germs and infect food and water, as in the case of typhoid fever (*see* para. 46).

"Carriers" may also play an important part in spreading the disease.

Conditions which lower the vitality of the body, and especially those which cause diarrhœa or irritation of the intestinal tract are of special importance as predisposing to infection.

248. The special measures to be taken for the prevention of dysentery are practically the same as in the case of enteric fever, namely, care in the disposal of excreta, the protection of food and water from contamination, and the early detection and segregation of the sick.

The camp site should be dry and well drained. Camping grounds that have been badly kept are specially to be avoided.

The quality of the food and its cooking are important, and the eating of fruit which is unripe or over-ripe should be prevented.

Unnecessary exposure to cold and wet or sudden changes of temperature, chill and excessive physical exertion must be avoided as far as possible.

Preventive inoculation against bacillary dysentery has been introduced.

DIARRHŒA.

249. Diarrhœa is a very common disease of troops in the field. There is a special form of the complaint known as epidemic diarrhœa, but it is also a symptom at the commencement of other diseases, such as enteric fever, dysentery, and cholera, and for this reason is of great importance.

Although simple diarrhœa is not so dangerous amongst men of the soldiers' age as amongst infants, it causes a great amount of temporary sickness and inefficiency among troops, and is indirectly the cause of mortality in the case of an army marching through a hostile territory where men, who have to fall out of the ranks on account of diarrhœa, are liable to be cut off. This happened during the Afghan wars.

250 It may affect numbers of men at the same time, especially in summer when its incidence is influenced by the

prevalence of flies. It is also rife in towns if the drains are not properly flushed and the scavenging and cleaning of the streets are bad.

Diarrhœa may be produced by a variety of causes. It is common in besieged places, where the diet is bad or monotonous, or wanting in some important particular.

Dirty water and water containing clay and mud will also cause diarrhœa, which may also be due to irritation from sand swallowed with the food.

Diarrhœa in epidemic form is attributed to a specific microbe, in which case the disease is spread by means of the excreta of patients, as in the case of dysentery and enteric fever.

Flies and dust are probably agents in conveying the microbe to healthy persons.

251. The measures to be taken for the prevention of diarrhœa are similar to those required in the case of enteric fever and dysentery.

Food, and especially milk and water, must be kept safe from contamination.

CHOLERA.

252. Cholera has in past years caused great mortality among troops, especially in India, where it always exists among the native population. It is liable to become epidemic at any time when sanitary care is relaxed.

It killed 10,000 British and French troops during the Crimean war.

Now that its cause and nature are fully understood, it is not so formidable as when it was an invisible and mysterious foe. Nevertheless, it annually destroys immense numbers of people, and no insanitary community is safe from an epidemic if it should once be imported into it.

253. The incubation period of cholera is from 3 to 10 days. The disease comes on generally very suddenly, but it may begin with a slight diarrhœa. There is violent purging, and vomitting of material resembling water in which rice has been boiled. The patient suffers from severe and painful cramps all over the body; the face becomes pinched and grey, and the body gets very cold.

In favourable cases the recovery is often rapid. On the other hand, death may occur in a few hours.

Mild ambulant cases occur, and during an epidemic slight attacks of diarrhœa are common and probably predispose a choleraic attack

254. The disease is caused by a vibrio, which is shaped like a comma. The germ is taken in by the mouth, usually in water, but also in food or anything contaminated by the specific germ.

It is disseminated by water and by means of articles of bedding and clothing which have been soiled with the discharge from the sick.

It survives for a considerable time under certain conditions, but exposure to the sun and drying kill it very quickly.

The habit of the natives of India of frequenting tanks and river banks, in order to obtain water for washing their persons after going to stool, is often responsible for the contamination of water. The germ may also be directly put into food that is handled by native servants with unwashed hands.

The disease has been practically stamped out in Indian communities, in which good water supply systems have been installed and protected from such methods of contamination.

Cholera follows the routes of troops, caravans and pilgrimages when sanitary methods are disregarded.

255. The chief measures of prevention are protection of food and water from contamination, careful purification of all drinking water, strict guarding against the careless deposit or disposal of excreta, a vigorous campaign against flies, and the early detection and isolation of the sick. All milk must be boiled, raw fruit and vegetables should be avoided, no washing is allowed near wells, and bathing places require careful supervision.

256. All indigestible diet should be avoided, especially unripe or over-ripe fruit, and clothing must be sufficient to avoid abdominal chill. Preventive inoculation is of value.

During cholera epidemics troops must be kept employed, and recreation must be provided. Unnecessary alarm or panic must be prevented.

UNDULANT (MEDITERRANEAN OR MALTA) FEVER.

257. Undulant fever is a disease which at one time crippled a large number of our soldiers.

It occurs, as its former name implies, principally in Malta and the Mediterranean stations, but it also occurs in India and China, and in South Africa.

258. It shows itself by successive attacks of continuous fever, each attack lasting for two or three weeks. In some cases this goes on for long periods of time. Cases, for example, have lasted for two years, and the average duration of the disease is 90 days.

There is pain in the joints that resembles an attack of rheumatism.

The period of incubation is 6 to 30 days.

One attack will protect from further attacks.

259. It is due to a micrococcus. The germ may possibly enter the body through the broken skin, but goats' milk is the outstanding factor in its transmission to man.

It passes out of the body in the excreta, particularly in the urine and fæces.

It is widely prevalent amongst goats, and in their milk, but milk products, such as cream, butter and cheese, also may harbour the germ.

The chief measure for preventing it, therefore, is avoidance of goats' milk (including products from goats' milk), or the boiling of it before use.

Since this measure has been adopted Mediterranean fever has practically disappeared from amongst the troops in Malta (Fig. 65).

INFECTIVE JAUNDICE.

260. This disease occurred amongst troops in the trenches in France and elsewhere during the Great War and has also occurred in barracks.

Rats form the source of infection, harbouring the germs in their bodies and passing them in their urine. Food, water, soil, &c., thus become infected and the germs easily reach man.

261. Preventive measures include the destruction of rats (*see* para. 226), the use of rat-proof larders and food stores, especially in the trenches, and strict attention to all items of general cleanliness that may prevent contamination of water or food.

TUBERCULOSIS.

262. Tubercle of the lungs, generally called "consumption," is the disease of all others in which the predisposing effects of overcrowding, lack of sunlight, and bad ventilation, stand out prominently.

It is an insidious disease and a man, without being aware of it, may be expectorating large numbers of germs every time that he coughs or spits. The germ is a bacillus which can survive for a long time in the dust of a room.

263. It is extremely important, therefore, that spitting of any kind should be prohibited in barrack rooms, that free ventilation be maintained and that overcrowding be avoided whenever possible.

264. Cows suffer extensively from tubercle, and, while infected milk probably plays no part in spreading the disease amongst soldiers, it is an important means of infection in children. It is important that married soldiers should realise the necessity of a safe milk supply for young families.

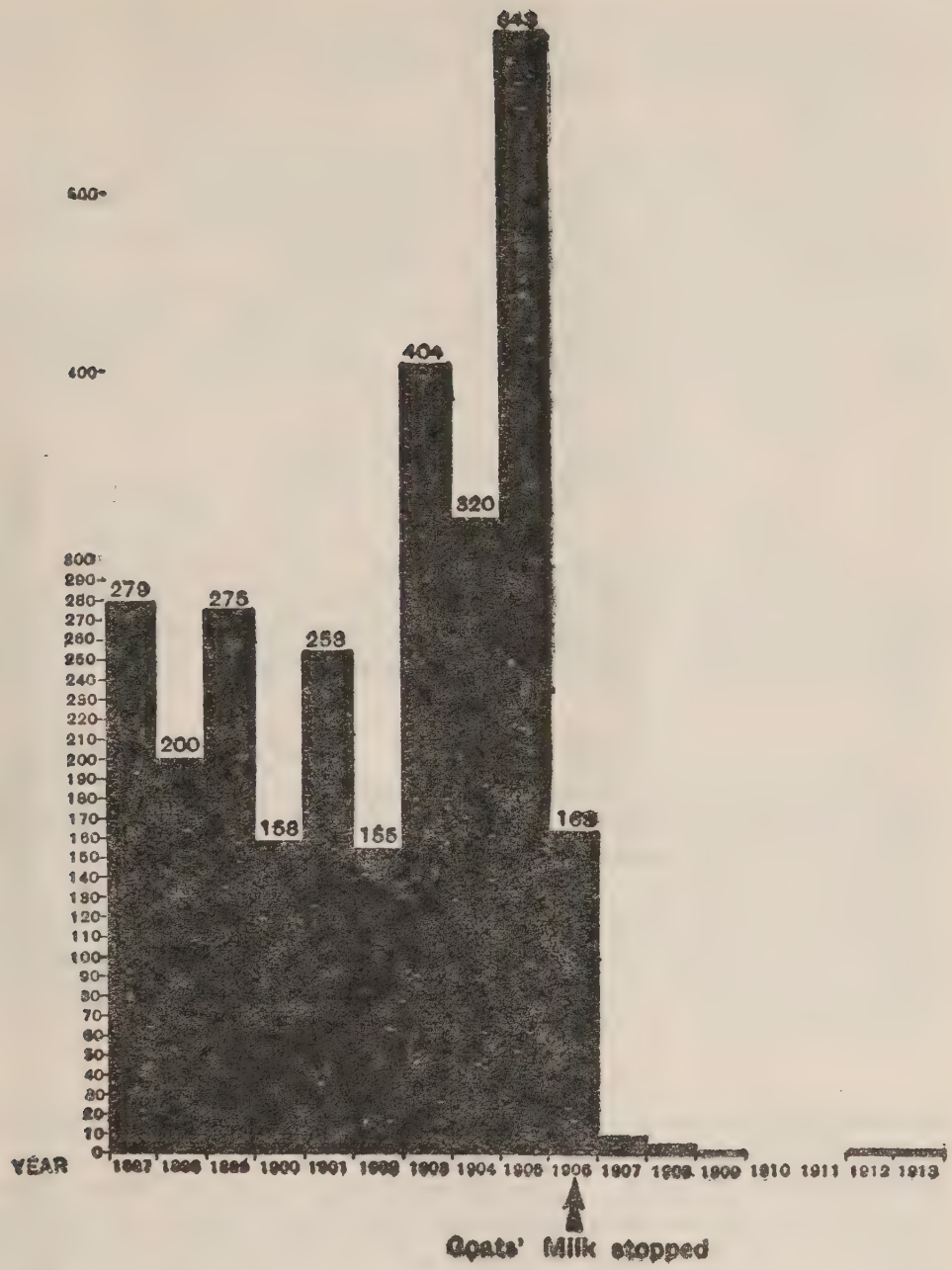


FIG. 65.—Undulant Fever. Number of cases occurring in the Troops in Malta during years 1897 to 1912.

INFLUENZA.

265. Influenza, and also ordinary colds, are spread from person to person by the secretions of the nose and throat. In coughing, sneezing, or loud talking these secretions, along with the contained disease germs, are discharged into the air for a considerable distance in the form of a fine spray

which is breathed in by neighbouring persons. This method of spread is known as "droplet infection," and is evidently greatly assisted by conditions of overcrowding or lack of ventilation.

266. Preventive measures, therefore, include the prevention of overcrowding and free ventilation (*see* paras. 92 and 93), and the avoidance during epidemics of crowded places such as cinemas, theatres and public meetings.

Gargling or insufflation with disinfectants under medical advice is of value, especially during outbreaks, in destroying germs which may have invaded the nose or throat. Preventive inoculation is of value.

CEREBRO-SPINAL MENINGITIS.

267. Cerebro-spinal meningitis is a disease affecting the nervous system and is spread by "droplet infection," the germs living in the nose and throat. A certain number of healthy persons ("carriers") will always be found who harbour the germs in their throats, and these are specially dangerous under conditions of overcrowding or bad ventilation.

268. Free ventilation (*see* paras. 92 and 93), adequate spacing between beds or bunks (*see* paras. 116 and 117), prohibition of spitting, and cleanliness of barrack-rooms are important preventive measures.

Where it is found, on medical examination, that a unit contains an excessive number of carriers, the medical officer should arrange for all men of the unit to be treated by steam inhalations, by which the germs in the throats of these "carriers" may be destroyed.

SMALL-POX.

269. Small-pox is now a rare disease in the Army as a result of the protection afforded by vaccination.

Previous to the discovery of vaccination, about the end of the eighteenth century, small-pox was a universal disease in Britain and it was exceptional for anyone to escape. Nowadays the disease is seldom seen at home, except amongst the unvaccinated civil population. It is still prevalent in both the near and the far East.

Vaccination in infancy does not protect an individual throughout the rest of his life, and re-vaccination should be done at from 12 to 16 years of age. Re-vaccination is always advisable when a person has been exposed to the danger of infection or is about to proceed abroad to any country where the disease is common, unless it has been successfully performed not more than two years previously.

TETANUS.

270. Tetanus (or lockjaw) results from the infection of wounds by the bacillus of the disease. The smallest wound, even a scratch or an insect bite, may become infected.

The bacillus is widely distributed in soil and is specially common in soil which has been much tilled or heavily manured. This fact explains the absence of tetanus in the South African war, where the battlefields were mostly uncultivated open veldt, and the prevalence of the disease in the Great War, where so much of the fighting took place in the highly cultivated lands of France and Flanders.

Thorough cleansing of all wounds, even the slightest wound if contaminated by dust or soil, is essential, and the routine administration of anti-tetanic serum to all wounded at the earliest possible moment proved a preventive measure of the greatest value.

SCABIES.

271. Scabies or itch is liable to affect large numbers of men under the unfavourable conditions incidental to active service. It is easily and quickly cured in the early stages, and much may be done to reduce the incidence by regular inspections and prompt isolation and treatment of the man, with disinfection of his kit.

The disease is spread by close contact either with men suffering from the disease or with infected clothing and bedding. It is caused by a tiny mite which burrows into the superficial layers of the skin, more especially affecting the genital region, the wrists, and the spaces between the fingers. This disease is often not recognised in its early stages owing to the difficulty of distinguishing the condition from that which results from lousiness.

INFLAMMATORY DISEASES OF THE SKIN.

272. These are due to infection by germs, which enter the skin through accidental pricks or scratches or may simply be rubbed into the skin by friction of clothing or equipment. Bites of body vermin and the consequent scratching greatly increase the liability to such conditions.

These diseases cause a large amount of sickness in all wars and emphasise the need for strict attention to personal cleanliness and adequate bathing facilities under all conditions of active service.

MALARIA.

273. Malaria is an important cause of sickness and inefficiency at all times amongst troops serving abroad and was the predominant disease in the Eastern campaign areas during the Great War.

274. It is caused by a germ which is carried from man to man by certain mosquitoes, and can be spread in no other way.

The mosquito is infected by biting a person suffering from malaria, possibly in a chronic form and therefore not obviously ill, and the germ passes through a stage of development in the body of the mosquito.

When the infected mosquito bites a man, it injects the germs into his body where these germs develop and mature in the blood in which they circulate, and produce at certain fixed periods immense numbers of young parasites, the attacks of fever and ague occurring at the time of their production. The ague fit may come on daily, every other day, every 72 hours, or irregularly, according to the type of parasite which has been acquired.

In what is called remittent fever, and in malignant fever, the attack comes on less regularly, and the fever lasts for a longer time than in ordinary ague.

275. The incubation period of malarial fever or ague, as it has long been called, is from 6 to 28 days. It has three successive stages :—

(*a*) A cold stage, during which the sick person looks and feels very cold; he may vomit, or even fall down as if in a faint, he shivers violently and craves for warmth; this stage may last for an hour or less.

(*b*) A hot stage of fever, during which the patient has a flushed face, feels very hot and throws off the bed clothes; this stage may last for four or five hours.

(*c*) A sweating stage, in which there is profuse perspiration, with complete relief and temporary recovery from the attack. The attack, however, returns at its appointed time according to the type of parasite in the blood.

276. In malaria it is often very difficult to decide when a real cure has been effected, relapses are of frequent occurrence, and it is particularly important that the instructions of the medical officer in regard to quinine and other treatment be complied with strictly and conscientiously, even though the patient may think that he has completely recovered.

Relapses and recurring attacks of malaria are very debilitating and are the causes of much invaliding from foreign stations.

277. The chief preventive measures against malaria are the avoidance of centres of infection, e.g., native villages, where mosquitoes are likely to be infected, the destruction of mosquitoes (*see* paras. 209 to 211) and the protection (*see* paras. 212 to 215) of troops against mosquito bites.

Measures to promote and maintain general bodily health are important; anything which lowers the vitality of the man,

such as fatigue, want of proper food, dissipation and physical exhaustion, predispose to attacks of the fever.

YELLOW FEVER.

278. Yellow fever has attacked our troops chiefly in the West Indies, Bermuda and the West Coast of Africa, but it may be, and has been, carried to many far-off ports—Gibraltar, for example, having been devastated by epidemics of the disease in the earlier part of last century.

In the year 1802 a French expedition to San Domingo lost 50,000 men out of 58,000 from it in the course of four months.

In 1878, 16,000 people died of it in the Southern States of America.

Its home is in the West Indies and South America.

Though it only occurs occasionally, it is a very formidable disease.

279. As in malaria the germ is spread from sick to healthy by a mosquito and infection can occur in no other way.

280. Preventive measures are similar to those adopted for malaria and thus include mosquito destruction and protectio of both patients and healthy persons from mosquito bites.

PHLEBOTOMUS FEVER.

281. This disease is also known as sand-fly fever and, though a fever of short duration and never fatal, it is responsible for much sickness and debility in areas where the disease is prevalent.

282. The germ is conveyed from man to man by a minute fly—the Phlebotomus or "sand-fly"—and preventive measures include dealing with the breeding places of the fly, destruction of adult flies and protection of troops by fine-mesh nets (*see* paras. 216 to 220).

PLAGUE.

283. This disease is usually met with in India and China, where epidemics are of common occurrence, but cases of the disease may appear anywhere, especially in sea-ports and amongst persons coming into contact with the natives.

It has of late years affected chiefly the native populations in endemic areas, but in the Middle Ages it devastated many countries in Europe, our own among them.

In some epidemics it has destroyed one-third of the population of the towns it has attacked.

It has accompanied armies and been carried by them into places previously unaffected.

284. The disease is caused by a bacillus and is characterised by high fever and painful swelling of the glands, generally in groin or armpit, and is hence called bubonic plague.

A very fatal form which is directly infectious is characterised by pneumonia, without swelling of glands.

The period of incubation is from 2 to 8 days.

285. The chief source of the germ in plague is the rat; plague is an epidemic and fatal disease amongst rats and a high mortality amongst the local rats is often one of the earliest warnings of a subsequent out-break in the human population.

Fleas carry the germs of the disease from one rat to another and from rats to man, and infected fleas may live for a long time in discarded clothing, rags, &c.

286. General insanitary conditions encouraging the prevalence of rats tend, therefore, to the spread of this disease, especially if associated with overcrowding. Natives who go about with bare legs and feet are especially liable to be infected. Men should therefore be kept from entering native abodes, and native servants must be inspected and kept under strict supervision.

287. The destruction of rats (*see* para. 226) and measures against fleas (*see* paras. 223 and 224) are the chief preventive factors. Preventive inoculation is of value and is essential for all personnel engaged on anti-plague duties.

TYPHUS FEVER.

288. Typhus fever has been in times past one of the most destructive diseases of armies, but, as the difference between it and typhoid fever was only discovered 60 years ago, much mortality that was ascribed to it may have been due to typhoid fever.

It was called spotted, camp, jail, or hospital fever.

In the Bavarian Army in 1812, 25,000 out of a strength of 28,000 men were affected.

After the battle of Plevna in the Russo-Turkish War, 60,000 out of a strength of 120,000 men were lost to the Russian army by this disease.

There are many equally striking instances of its ravages.

It is still a disease affecting troops in South-Eastern Europe, and in large cities elsewhere; it is occasionally found among the very poor, and in crowded and dirty populations, but improved sanitation has practically stamped it out in modern towns.

It is liable to attack troops in a besieged place or wherever the surroundings are insanitary and the quarters overcrowded.

289. The germs of the disease are spread from man to man only through the agency of lice (*see* para. 47).

The chief preventive measures, therefore, are regular disinfestation of clothing (*see* paras. 230 to 234), and the avoidance of contact with natives, refugees, &c., in areas where the disease is prevalent.

TRENCH FEVER.

290. Trench fever is a disease which in modern warfare has been responsible for an enormous wastage of man-power. The onset is sudden and the affection is characterised by headache, dizziness, pain in the back and legs, and rise of temperature. Though the death-rate from this disease is practically nil, the sickness rate under active service conditions is very high, and every effort should be made to reduce the incidence in the interests of military efficiency. The disease is conveyed from man to man by the louse, and thorough and periodical disinfestation (*see* paras. 230 to 234) is the best method of dealing with the problem. Every advantage must be taken of the bathing facilities offered to troops in the field.

SCHISTOSOMIASIS (BILHARZIA DISEASE).

291. This disease is widespread in Africa, especially in Egypt, and is known to exist also in Mesopotamia and the West Indies. It is a serious disease, because of its long duration and difficulty of cure leading to conditions of chronic ill-health.

292. The disease is due to the invasion of the body by a species of worm. The young immature worms live in certain species of snails, from which they pass in vast numbers into the surrounding water. On gaining access to a person's skin (or the interior of mouth or throat) they penetrate the surface and gain entrance to the body, where they develop into the adult parasites.

The disease, therefore, is contracted by personal contact (drinking, bathing, washing, wading, &c.) with infected water.

293. In order to prevent the disease snails must first be excluded from the water, which is then treated by storage for forty-eight hours, the use of acid sodium sulphate tablets (*see* para. 83), or boiling. Ordinary chlorination does not kill the young worms, and must be used in considerably stronger concentration than usual for this purpose. Ablution and bathing water (provided that the snails are excluded) may be treated with one and a half ounces of cresol in every hundred gallons.

SCURVY.

294. Scurvy is not a communicable disease, but it has been the cause of an immense amount of sickness and of deaths

in armies, and is especially liable to occur amongst beleaguered garrisons and on board ship in conditions under which fresh food supplies cannot be obtained.

In the Crimean War the Turkish army was nearly destroyed by it, and there were 40,000 cases in the allied English and French armies.

It occurred to some extent during the South African War, more especially in besieged places, but also on the line of march, when preserved rations only were obtainable. It was also very prevalent amongst Asiatic and African troops recently in Somaliland, and was one of the causes that led to the capitulation of Port Arthur in the Russo-Japanese War.

295. The disease appears at first in the form of pains in the calves of the legs. Afterwards the gums become swollen and marks like bruises appear on the body.

Diarrhœa and other severe complications, such as dropsy, pleurisy, anæmia and heart failure may occur, and the mortality then is great.

296. Scurvy is due to the deficiency or absence in a diet of a certain "vitamin" (*see* para. 15), which is chiefly contained in fresh meat, vegetables and fruit. It may appear, even when a ration contains sufficient of these items, if the vitamin is constantly destroyed by prolonged cooking.

297. Scurvy may be prevented by the issue of fresh meat, fruit and vegetables, and when these cannot be obtained or are obtainable only in deficient quantities germinated peas or beans have been found a suitable substitute, and on that account are important items in the soldier's ration in the field and on board ship. It is important that these germinated pulses should be cooked and eaten as soon as possible after germination (*see* Appendix X).

HEAT STROKE.

298. A variety of conditions are included under the term "heat stroke"; they may occur in any part of the tropics where there is a high air temperature, especially if the air is moist and "muggy." Mild forms are met with even in England during the summer.

299. Excluding true sunstroke, which is due to the direct action of the sun's rays on the coverings of the brain or the eyes, the essential cause in all cases is the retention of surplus heat in the body (*see* paras. 16 and 17). This may result from an over-production of heat owing to very heavy work, excessive load, &c., or from conditions hindering heat loss, such as high air temperatures, moist air preventing evaporation of sweat, thick or tight clothing preventing body ventilation, stagnant air, as in ill-ventilated rooms and tents, &c., or to a combination of both causes.

Constipation, over-indulgence in alcohol, and conditions of debility are predisposing causes.

300. Preventive measures include protection of head and eyes from the direct rays of the sun and avoidance of all predisposing conditions, especially alcoholic excess. Clothing should be light and loose; the loads carried by men should be reduced to a minimum; coats and shirts should be worn open; on the march the most open order practicable should be allowed, with frequent halts; as far as possible troops should not march in the heat of the day.

TRENCH FOOT.

301. Trench foot has proved a serious cause of loss of man-power under certain conditions of modern warfare. By training and strict discipline the danger may be practically eliminated. The condition must be clearly distinguished from frost bite; cold is merely a contributory factor; moisture, pressure and inactivity all play a part in producing this condition, whilst age is important in view of the fact that the young are more frequently affected.

302. The main factors in the causation of this disease are tight boots, tight puttees, the strained position incumbent upon men crowded into cramped front-line trenches, fatigue, pressure at the back of the leg due to sitting on the firing step, and the sodden condition of the skin, due to constant soaking.

Under these conditions the skin is liable to be attacked by germs found in mud and stagnant water, especially if the cleanliness of the feet and toes is neglected.

303. Preventive measures include cleanliness and disinfection of the feet by means of a medicated soft soap containing powdered camphor and borax, daily removal of boots and massage of the feet, frequent changing of socks, which should be dusted inside with a camphorated talc powder; encouragement of activity—puttees loosely wound, bootlaces loosely tied, short periods of duty in wet trenches and general measures such as drainage, provision of duck boards, and an adequate supply of hot food, soup, &c.

Trench foot is a disease in which preventive measures essentially concern company and platoon officers, and the orders issued in France and elsewhere for its prevention should be carefully studied. (Appendix VII.)

VENEREAL DISEASES.

304. These diseases cause more inefficiency and suffering than any other form of preventable disease. Under this head are included two distinct forms of affections, viz., syphilis and gonorrhœa, which comprise over nine-tenths of venereal diseases.

305. Syphilis is a constitutional disease which, unless it is inherited from the parents, gains access to the system through some small abrasion, usually, but not always, on the external genital organs. Five out of six of the sores occurring on the penis are syphilitic.

The disease is characterised by three stages which are not clearly separated from one another.

The first stage is marked by the presence of a sore or ulcer on some part of the body—penis, lip, tongue, &c., which has been exposed to infection. It is important to remember that the syphilitic sore is very often quite painless.

The second stage, when the whole constitution is involved, may be, but is not necessarily, marked by painless ulcers in the throat; various skin rashes which do not itch, and loss of hair; more rarely, serious affections of the eyes, ears, lips and tongue, and even paralysis or insanity may occur. In this, as well as in the primary stage, the discharges from the sores on the genitals and other parts of the body are contagious and may easily convey the disease to other persons, whether by sexual intercourse or through the common use of towels, feeding utensils, &c.

The third stage supervenes in the course of months or years if the treatment is not carried out efficiently and for a sufficient length of time. It is characterised by ulcers and swellings in various parts of the body, disease of the bones and very grave affections of the brain and spinal cord such as general paralysis of the insane and locomotor ataxy.

The seriousness of syphilis is increased by the fact that it renders a soldier inefficient for a long time, and also because if he marries before he is cured he may give it to his wife, and his children may be infected. Syphilis in children is more serious than in adults and very often leads to early death, crippling, deafness, blindness or idiocy.

The usual source of infection is sexual intercourse, but as the germ may enter through any cut or abrasion, the disease may be acquired in other ways, for instance by smoking the pipe of a diseased comrade, or kissing a person with a syphilitic sore on the lip or tongue.

306. Gonorrhœa is far more common than syphilis and is also often followed by very grave consequences.

It is caused by a germ, which in a very few days sets up a violent inflammation in the urethra (water pipe), scalding in passing water and a copious discharge. Swelling of the testicles and consequent sterility, a dangerous affection of the eyes, and a troublesome form of rheumatism may also occur. Following an attack of gonorrhœa, a stricture or narrowing of the urinary passage may take place, which, if neglected, may cause disease of the bladder and kidneys.

The treatment is difficult and tedious. If it is not begun early and carried out efficiently, patients, though apparently cured, may convey the disease to women, who may suffer from complications even more dangerous than those which occur in men.

Gonorrhœa is almost always caught by sexual intercourse, but the infection may be conveyed to the eyes, even when the discharge has almost disappeared, by means of the hand or by using the towel of a man suffering from the disease. Patients should, therefore, be very careful about washing their hands and seeing that they do not soil lavatories for fear that healthy people may be infected. Towels, nail and tooth brushes belonging to patients should never be used by others.

307. Having regard to the usual mode of infection, the only sure preventive measure against venereal diseases is abstention from promiscuous intercourse with women. Manly chastity must be encouraged; it is a mistaken idea that sexual intercourse is necessary to maintain health.

308. The provision of facilities for healthful exercise, and amusement, outdoor and indoor, for use by day or in the evenings is essential, and it is the duty of regimental officers to organise and ensure opportunities for athletic and social recreation for the men under their command.

309. Venereal diseases are communicable diseases, caused by germs which invade the body, and the ordinary principles of prevention for any communicable disease are applicable.

Measures directed against the source of infection are, however, difficult to apply in practice, the route of infection is direct physical contact, and protection of the healthy man furnishes, therefore, the best line of sanitary defence.

Immediate washing and disinfection of the genital organs after any exposure to infection should be thoroughly performed. Small outfits for this purpose, which can be carried in the pocket, furnish the best means of applying this treatment *without delay*, and they should always be available in barracks for issue to men who desire them. It is essential that a man who intends to take advantage of this outfit be instructed in the correct method of using it.

310. While these outfits undoubtedly lessen the risk of contracting disease, they cannot be regarded as a certain means of protection. If disinfection has failed to protect, and disease appears, immediate medical treatment is essential. It is most important to remember that after the disease has commenced, every day's delay lessens the chances of cure. It is the height of folly to delay seeking the advice of the medical officer or to apply some chemist's or quack's remedy.

A soldier who does these things is not only his own enemy, but the enemy of his comrades, since he may easily convey the disease to them. A soldier who has indulged in illicit sexual intercourse should (whether he has disinfected afterwards or not) keep a close watch on his genital organs for a month or six weeks afterwards. If the least itchiness is felt at the end of the pipe; if there is the slightest discharge; if any spot appears, or the foreskin becomes swollen, he should report sick at once.

A soldier who neglects to report sick without delay, when suffering from venereal disease, is guilty of a military offence (para. 520, King's Regulations).

CHAPTER VIII

SANITARY ORGANIZATION ON ACTIVE SERVICE

311. The sanitary organization of an army in the field is based upon three principles :—

(*a*) The commander of every unit and formation is responsible for the sanitary condition of the quarters or localities occupied by his command and for taking all measures necessary for the preservation of the health of those under him.

(*b*) Every commander has available a representative of the medical services responsible for giving advice and technical recommendations in regard to all measures necessary for the maintenance of health and the prevention of disease.

(*c*) Special sanitary personnel is provided in all units, formations and areas to supervise and carry out sanitary measures beyond the skill or training of the troops.

312. Thus the Director-General of Medical Services at General Headquarters is the responsible adviser of the C.-in-C. of the Force on all sanitary matters. Directors, Deputy Directors and Assistant Directors of Medical Services similarly are the advisers of Army, Corps and Divisional Commanders or Commanders of sub-areas and bases on the lines of communication. The C.O. of each Unit is advised by the officer in medical charge.

In independent brigades the senior officer of the medical service with the formation may be deputed to act as adviser to the brigade commander.

313. In the case of large formations or important areas the responsible officer of the medical services is assisted by one or more officers on his staff, who are specialists in hygiene and sanitation, Assistant and Deputy-Assistant Directors of Hygiene (*see* Appendix VIII).

314. To supervise and carry out measures of a technical nature, certain sanitary units—sanitary sections—are formed on mobilization. One section is included in each division or cavalry division and the remainder are allotted by the Director-General of Medical Services at General Headquarters to formations and areas as circumstances demand. Each sanitary section is commanded by an officer, R.A.M.C., specially trained in sanitary duties, and has a fixed establishment of trained N.C.Os. and men. Unskilled labour personnel, either from the army or hired locally, may be attached to it if considered necessary.

Areas occupied by troops, whether at the front, on the lines of communication, or at the base, are divided into definite sanitary districts, and a sanitary section is put in charge of each district.

When the duties are heavy, a district may be divided into sub-districts and a sanitary section placed in charge of each; or one or more detachments of trained sanitary personnel may be added to the sanitary section in charge of the district. Sanitary sections are so constituted that they can, if necessary, furnish detachments of greater or less numbers, and frequently one or more such detachments are allotted to railheads or important halting places on the lines of communication.

315. In trench warfare divisional sanitary sections are usually allotted to specified areas or districts at the front and remain there, even when the divisions to which they belong are moved; but in a war of movement these sections move with their own divisions.

316. The duties of sanitary sections consist of :—

(*a*) Skilled supervision of labour employed in the removal and destruction of excreta and refuse and in the construction of latrines, and other sanitary works.

(*b*) Disinfection of billets and of clothing and other articles when infectious disease occurs.

(*c*) Supervision of bathing and disinfestation stations.

(*d*) Purification and protection of water supplies.

(*e*) Sanitary police duties.

They are also available to give instruction to units in technical sanitary matters. They do not as a rule carry out the construction of elaborate sanitary appliances, such work

being allotted to the Royal Engineers. In many respects the duties of N.C.Os. and men of these units are similar to those of sanitary inspectors in civil life.

Although the personnel of sanitary sections is thus available to give technical advice and assistance to units, their existence in no way relieves a single unit of its ceaseless responsibility for its own sanitation.

317. Every unit is provided with regimental sanitary personnel, each unit having on its establishment a detachment trained in sanitary duties varying in strength according to the size of the unit. This detachment is responsible not only for sanitary police duties in the area occupied by the unit, but also for the performance of all sanitary and conservancy duties in the unit, which are not carried out under contract. When certain conservancy duties, such as the disposal of excreta and refuse, are carried out by a contractor the unit sanitary personnel are responsible for the supervision of the work, and for seeing that it is performed in a satisfactory manner.

In addition there is in each unit another detachment, also part of the establishment, consisting of men who have received special training in methods of purification and protection of water supplies.

Thus each unit is self-contained as regards its sanitary and water duty personnel who accompany it wherever it goes and operate whether the unit is serving as a whole or is split up into detachments. Each unit is therefore able to carry out essential sanitary measures for itself, though these may be supplemented by a more elaborate sanitary organization, in which the sanitary sections play their part.

The existence of regimental sanitary detachments does not relieve a single other individual in the unit from his normal responsibility for strict attention to all matters of sanitation. The tendency to throw all sanitary work upon the regimental sanitary detachment or, still worse, to penalise it for what is really company or regimental slovenliness must not be permitted.

The officer in medical charge of a unit is responsible to the C.O. for the efficient performance of the work of the regimental sanitary and water detachments, and this personnel should therefore be placed definitely under his orders.

318. In addition to the organization which has been outlined above, the sanitary service of an army in the field is supplemented by mobile hygiene and bacteriological laboratories, which are staffed by specially-trained personnel and are utilised for carrying out investigations on particular problems connected with the health of the troops.

319. Two non-medical units play so important a part in sanitation that they require mention in this chapter.

Water Tank M.T. companies may be mobilized. The transport personnel of these units is found by the R.A.S.C., and they are commanded by R.A.S.C. officers. They have, however, attached to them R.A.M.C. officers who are trained in chemistry, also certain trained N.C.Os. and men of the R.A.M.C. The duties of this attached personnel are in connection with the examination and purification of water supply, which is then distributed in tank lorries by the R.A.S.C. personnel.

Special units may also be mobilized to maintain the personal cleanliness of troops in the field. These will consist of sections which establish bathing and disinfecting centres as far forward as possible and laundry centres for washing and repair of clothing in rearward areas.

320. There exists in peace an Army Hygiene Advisory Committee appointed to advise and assist the medical services in all matters affecting the health of troops. During active operations a similar committee may proceed overseas and perform parallel duties with the forces in the field.

321. The principal duties of such a Committee would be as follows :—

(*a*) To assist general officers and the medical service in their efforts to maintain the health of the army by co-ordinating not only the work of the different military branches but also that of the military with the civil sanitary organization of the country or area occupied, should such organization already exist.

(*b*) To initiate important schemes of general sanitation, and to serve as a board of reference for the solution of sanitary problems.

(*c*) To visit and inspect stations occupied by troops, to advise local authorities regarding necessary sanitary measures and to further in every way the maintenance of satisfactory sanitary conditions, reporting to headquarters any measures which they consider necessary, but which they cannot arrange to be carried out locally.

(*d*) To ascertain what sanitary appliances and materials are required for the army, and to see that an adequate reserve is maintained.

322. It will thus be seen that in regard to responsibility for sanitation the duties of the medical services are chiefly advisory and supervisory and that the actual performance of

sanitary work is the duty not only of commanding officers, who, in addition, are responsible for the due observance of sanitary orders by all under their command, but also of every officer, N.C.O. and man throughout the entire force in the field.

APPENDIX I

INSTRUCTIONS FOR THE USE OF "CASES, WATER TESTING, STERILIZATION (1917 PATTERN)"

DESCRIPTION OF CONTENTS.

The contents of the case are as follows:—

Six white enamelled cups, holding $\frac{1}{3}$-pint of water when filled nearly to the brim.

One black enamelled cup, with mark on inside.

Two metal spoons, each holding 2 grammes when filled with powder level with the brim. They are similar to the measure contained in the $\frac{1}{4}$-pound tin of sterilizing powder (chlorine).

One stock bottle of zinc-iodide and starch test solution, and one dropping bottle. Three drops of the solution give a definite blue colour with water containing one part per million of free chlorine.

Six glass tubes, or pipettes, each of such dimensions that a drop of standard chlorine solution delivered by it, when held in a vertical position, into a white cup filled with water gives a dilution of chlorine of one part per million.

Four glass stirring rods.

Twelve pipe cleaners.

Two copies of Instruction.

METHOD OF USING.

Clarified water from the cart is used. The test is best carried out while the cart is being filled, an operation which takes about half an hour.

1. Prepare a standard solution of chlorine in the black cup as follows :—

Put into the black cup one level spoonful of the solid sterilizing powder (chlorine), make it into a smooth paste with a little water by stirring it with a glass stirrer and carefully breaking up all lumps. Add more water to the paste and fill the black cup with water to the mark on the inside. Stir vigorously

and leave the glass rod in the black cup. This solution is never clear, as it contains lime in suspension, which, however, gradually settles. Put into the solution one of the glass pipettes.

2. Fill the six white cups with clarified water to within a quarter of an inch of the top.

3. Add drops of the standard chlorine solution from the pipette to the water in the white cups so that they contain 1, 2, 3, 4, 5, 6 drops respectively. Stir each thoroughly with a clean stirring rod and leave this stirring rod in one of the cups. Allow the cups to stand for half an hour.

NOTE.—In order to add even drops of the standard chlorine powder solution to the cups it is necessary that the top of the pipette and also the finger should be quite dry. Pressure of the finger on the pipette keeps the liquid from running out. By the gradual release of pressure a continuous series of drops can be made to fall from the pipette. A novice can soon learn the method of dropping by practising a few times with the solution out of the black cup.

4. After half an hour add three drops of the zinc-iodide and starch test solution from the dropping bottle, or directly from the stock bottle to each of the white cups and stir each with the stirring rod left in one of the cups.

5. Some of the six white cups will show no colour, some will show a blue colour. **The first of the cups showing a blue colour,** that is the one containing the smallest number of drops, is noted. Say cups 1, 2, 3 show no colour, but cups 4, 5, 6 show a blue colour, then cup No. 4 is the one to be noted. The water therefore requires four parts of chlorine per million to sterilise it. If none of the cups show a blue colour the cups are washed out and the test is performed again with 7, 8, 9, 10, 11, 12 drops of the chlorine solution in the cups.

6. Each drop of chlorine solution in a white cup corresponds to a spoonful of sterilizing powder (chlorine) to a full water-cart of 110 gallons. Four spoonfuls of sterilizing powder (chlorine), corresponding to the four drops, are thus required for the cart in the instance given in the foregoing paragraph.

7. The sterilizing powder (chlorine) must not be added in the solid form to the water in the water-cart. It must be made into a paste with water in the black cup and diluted in the same way as in the preparation of the standard solution.

It is better to add a solution of one spoonful of sterilizing powder (chlorine) at a time rather than a solution of several

spoonfuls. The original standard solution can be added as one measure and the extra measures prepared in the now empty black cup.

If the body of the water-cart is divided into compartments by means of baffle plates, the solution is divided equally between the compartments.

8. The solution of chlorine must be thoroughly mixed with the water in the cart:

(*a*) By stirring with a stick thoroughly washed with clarified water.

(*b*) By filling the cart half full, adding the solution of chlorine and then rapidly filling completely.

9. The water in the cart should always be tested at the end of half an hour, when it should show a faint blue colour on the addition of three drops of the zinc-iodide and starch test solution to some of it in a white cup.

10. Water for drinking must not be drawn from the cart until half an hour at least has passed. It should be left in the cart as long as possible, preferably until the following morning.

11. If the water be used immediately after the lapse of half an hour it may have a slight taste of chlorine. The taste disappears on standing, the water then containing nothing but lime salts, which are present in every hard water. It is, therefore, advantageous to prepare water well in advance of the time when it is required.

NOTE.—If water be urgently required, the zinc-iodide and starch test solution may be added to the white cups immediately after the drops of chlorine solution, and the corresponding measures of sterilizing powder (chlorine) added to the cart while it is being filled.

APPENDIX II

SPACING RECOMMENDED FOR BRITISH TROOPS IN BARRACKS

Stations	Height to wall plate or ceiling (feet)	Floor space per head (square feet)	Cubic space per head (cubic feet)
A. Home stations	10	60	600
B. Gibraltar and Malta	12	60	720
C. Cyprus, Ceylon (Hill stations), Hong Kong Peak, and Bermuda	12	70	840
D. North China	11	70	770
E. Egypt, Ceylon (Coast), South China (except Hong Kong Peak), Mauritius, West African Hill stations, and West Indies	13	80	1,040
F. Soudan, West Africa (Plains), and Straits Settlements ..	14	100	1,400

N.B.—Not less than six feet linear wall space should be allowed for each man in barrack rooms.

APPENDIX III

SUGGESTED ROUTINE FOR THE CARE OF FEET AT THE END OF A MARCH

1. Remove boots; dry; dubbin.

2. Wash and dry socks; rub them until soft; darn, but leave no ridges.

3. Wash feet in cold water; rub with spirit, or alum solution; treat blisters, abrasions, etc.; dust with foot powder.

4. Put on clean socks and shoes.

N.B.—A useful foot powder is:—

Salicylic acid	3 parts.
Boric acid	10 ,,
Talc	87 ,,

APPENDIX IV

ARRANGEMENTS FOR INSTRUCTION AT A CORPS SCHOOL OF HYGIENE AND SANITATION

1. *Subjects Taught.*—A Corps School of Sanitation should be formed at each corps rest camp for instruction of officers and men in hygiene and sanitation.

2. *Duration of Course.*—Each course will last six days. Officers, N.C.Os. and men will be chosen from residents in the camp.

3. *School Staff.*—The staff will consist of:—The Commandant, who will be the commandant of the corps rest camp; assistant commandant (who should have special knowledge of hygiene); instructors—two serjeants from sanitary sections; assistant instructors—two corporals from sanitary sections.

4. *Number attending each Course.*—Fifty.

5. *Special Lectures.*—Special lectures will be arranged each week when possible. All students must attend these special lectures.

6. *Instruction in Sanitation.*—This consists of:—(*a*) A course of lectures in accordance with attached syllabus; (*b*) practical classes in the manufacture of sanitary appliances; (*c*) instruction by means of models. A collection of models of sanitary appliances will be arranged.

7. First aid and chiropody may also be taught at this school, and for this purpose three corporals from field ambulances will be required as assistant instructors.

SYLLABUS.

Time.	Subject.
Monday—	
9.30 a.m.	General principles of preventing disease.
10.30 a.m.	Air and ventilation. Insects and diseases, with special reference to flies, lice, mosquitoes, &c.
1.30 p.m.	Practical instruction in water testing.
2.30 p.m.	Water-carts, water-bottles and water-tanks. Their care and management.
3.30 p.m.	Practical demonstration on construction of urinals and latrines.
5. 0 p.m.	Personal cleanliness and physical culture.

Tuesday—

9.30 a.m. Food and food storage and the principles of cooking.
10.30 a.m. Personal hygiene and the prevention of scabies and lice.
1.30 p.m. to 5. 0 p.m. Practical demonstration on cook-houses, camp baths, and latrines.

Wednesday—

9. 0 a.m. to 12 noon Latrines, trench, and urine pits.
1.30 p.m. Infectious and contagious diseases.
2.45 p.m. Practical work in the construction of improvised meat safes and food stores.

Thursday—

9.30 a.m. Bivouacs, camps and billets.
10.30 a.m. Disposal of excreta and refuse, and demonstrations of working of destructors.
2. 0 p.m. to 4. 0 p.m. Water and water supplies, with practical demonstration of source of supplies.

Friday—

9.30 a.m. to 12 noon Camp construction and camp drainage.
2. 0 p.m. Disinfectants, their use and abuse.
3. 0 p.m. to 5. 0 p.m. Demonstration of various methods of disinfecting and disinfesting.

Saturday—

9. 0 a.m. Sanitary arrangements in trenches.
10.30 a.m. Demonstration on trench latrines and urinals.
11.45 a.m. Final lecture.
2. 0 p.m. Class dismissed.

Classes for constructional work will be held each evening from 7.0 to 8.0 p.m. by the sanitary instructors. This work will embrace the making of improvised meat-safes, urinals, latrine seats, incinerators, &c., &c.

Samples and models of various contrivances used in camp sanitation will be exhibited and the working explained.

APPENDIX V

FORMULAE FOR FLY-POISONS, MOSQUITO REPELLANTS, VERMIN PASTES, ETC.

(*a*) *Tangle-foot for fly-papers, wires, &c.* :—

Castor oil	5 parts	by weight
Resin	8 ,,	

Heat the castor oil in a tin or pan and add the resin with constant stirring until it is dissolved. Smear the mixture while hot, on wires or paper. The paper must be glazed, as unglazed paper absorbs the oil.

(*b*) *Arsenic solution:*—

Usually supplied in the form of tablets of arsenite of soda, coloured with an aniline dye and sweetened. One tablet dissolved in three and a half ounces of water (6 tablets to one pint) makes a one per cent. solution. Remember that arsenic is a deadly **poison.**

(*c*) *Formalin solution:*—

Formalin is a solution of a gas (formaldehyde) in water and therefore deteriorates if the bottle is left uncorked.

Formalin	One dessert spoonful.
Sugar..	One dessert spoonful.
Water	One pint.

Lime water should be used in preference to plain water or half a teaspoonful of washing soda may be added to the mixture.

(*d*) *Fly Spray* (Lefroy's fluid) :—

Pyrethrum powder	2 pounds
Methylated spirit	1 gallon
Saffrol	1 gallon
Aniline	1 ounce

For use dilute with 20 volumes of water or preferably of soap solution; 10 c.c. of the undiluted solution is sufficient to spray 1,000 cubic feet.

(*e*) *Oil for surface of mosquito pools* :—

Paraffin oil	1 part.
Heavy oil	2 parts.

For spraying, half-a-pint will cover one hundred square feet; for drips, allow mixture to drop at the rate of twenty drops a minute.

(*f*) *Cresol for mosquito pools :—*

Estimate approximate water content of pool and allow one gallon of cresol for each eighty thousand gallons of water. Cresol must be made up into an emulsion with five times its bulk of water, before being put into pools and must be well mixed in the pool.

(*g*) *Mosquito repellent ointments :—*

Oil of Cassia		1 part.
Brown oil of camphor		2 parts.
Lanoline, Vaseline, Olive oil	Mixed according to climate	.. 3 ,,

"Bamber oil" consists of :

Oil of Citronella	1½ parts.
Coconut oil	2 ,,
Paraffin oil	1 part.

Add carbolic acid up to ½ or 1 per cent.

(*h*) *Cresol and soft soap emulsion for fleas :—*

Cresol	5 parts.
Soft soap	20 ,,
Water	75 ,,

The cresol and soft soap are added to the *hot* water with continuous stirring. For use make a 5 per cent. solution with water.

(*i*) *Paraffin and soft soap emulsion for fleas :—*

Hard soap	1 lb. (or soft soap 1½ lbs.)
Paraffin oil.. ..	4 gallons.
Hot water	1 gallon.

Dissolve the soap in the hot water; add very gradually the paraffin oil, with continuous stirring. For use dilute to 5 per cent. with water.

(*j*) *N.C.I. Powder :—*

Crude unwhizzed naphthalene in powder	96 parts.
Creosote	2 ,,
Iodoform	2 ,,

Mix to form a fine powder.

(*k*) *Rat poisons :—*

(i) Barium carbonate	2 parts.
Flour, meal, &c.	5 ,,
Salt	1 part.
Lard or dripping	Sufficient to make a paste.

(ii) Phosphorus .. .. 2 parts.
Lard .. .. 98 ,,

Use as a paste spread on bread, meat, &c.

(*l*) *Camphor and carbolic acid fumigation :—*

Camphor } .. .. .. Equal parts.
Carbolic acid }

Four ounces of the mixture are required for each thousand cubic feet of space. Place in a metal basin over a spirit lamp until the whole liquid has been driven off.

(*m*) *Cresol fumigation :—*

Place one ounce of cresol (Liquor cresoli saponatus fortis) in a metal basin or tray and heat over a spirit lamp until dry. Alternatively, the cresol may be allowed to drop slowly on to a hot metal plate.

(*n*) *Cresol disinfectant :—*

To make a one per cent. solution for general use take :—

Cresol .. .. 1½ ounces.
Water .. .. 1 gallon.

When the mixture has to be made with sea water or brackish water, first make up a strong mixture of cresol with four or five times its bulk of fresh water, mix well, then add the required amount of sea water.

APPENDIX VI

MOSQUITO NETTING

Wire gauze :—The mesh is calculated by counting the number of holes to a linear inch. The size of the opening depends upon the count per inch and the thickness of the wire. A mesh of 14 holes to the inch, with wire of 30 I.S.W.G., will exclude mosquitoes.

Cotton netting :—The mesh will be seen to consist of two series of holes, the lines intersecting each other at an angle of about 60 degrees. The mesh is the sum of the numbers of holes counted along both lines within an area of one inch square, the hole at the angle of the square, where the two lines meet, is counted twice (Fig. 66).

Cotton thread is standardized according to weight, being described as "30," "40," "50," &c., the higher number being the thinner thread. Netting where both warp and

bobbin are the same thread is described, for example, as "30/s"; if, for example, "40" is used for warp and "60" in the bobbin, the netting is said to be woven of "40/60."

The size of the holes clearly depends upon the count and the thickness of the threads.

Cotton netting of a mesh of 28 to 29 holes in the square inch, counted as above, and made of 30/40 cotton, will exclude mosquitoes under natural conditions.

Mosquito nets may be fire-proofed by dipping them into a solution of sal ammoniac (1 ounce to a pint of water), wringing lightly and allowing to dry.

A mesh of 46 holes to the square inch, counted as above, and made of 120/s cotton will exclude Phlebotomi.

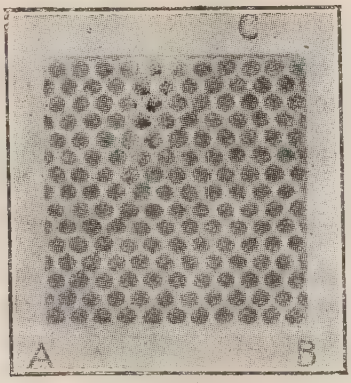


FIG. 66.—Mesh of cotton mosquito netting to shew method of counting. The mesh of this net is the sum of the counts made along the lines A B and A C, the hole at A being counted twice.

APPENDIX VII

SUGGESTED ORDERS FOR THE PREVENTION OF TRENCH FOOT

(*See also Official History of the War, Medical Services, Hygiene of the War, Vol. II.*)

1. This condition is caused by:—

   (*a*) Prolonged standing in cold water or mud.
   (*b*) The continual wearing of wet socks, boots, and puttees.

2. It is brought on much more rapidly when the blood circulation in the feet and legs is interfered with by the use

of tight boots, tight puttees, or the wearing of anything calculated to cause constriction of the lower limbs.

3. It can be prevented or diminished by:—

(*a*) Improvements to trenches leading to dry standing and warmth.

(*b*) Reducing the time spent in the trenches as far as the military situation permits.

(*c*) Regimental arrangements ensuring that, so far as is possible, men enter the trenches warmly clad in dry boots, socks, trousers, and puttees, and with the skin well rubbed with warm whale oil or anti-frostbite grease.

(*d*) Provision of warm food in the trenches when possible.

(*e*) Movement when possible, so as to maintain blood circulation.

(*f*) The provision of warmth, shelter, hot food, and facilities for washing the feet and drying wet clothes for men leaving the trenches.

4. In order to minimize the prevalence of trench foot commanding officers will be held responsible that the following instructions are carried out unremittingly and under the strictest supervision:—

(*a*) Before entering the trenches, feet and legs will be washed and dried, then well rubbed with warm whale oil or anti-frostbite grease and dry socks put on. It is of the utmost importance that warm whale oil or anti-frostbite grease should not merely be applied but thoroughly rubbed in until the skin is dry. Unless this precaution is systematically carried out the oil and grease become in a great measure valueless.

(*b*) A second pair of dry socks will be carried by each man, and where possible, battalion arrangements will be made for socks to be dried and re-issued during each tour of duty in the trenches.

(*c*) While in the trenches boots and socks will be taken off from time to time, if circumstances permit, the feet dried, well rubbed, and dry socks put on.

(*d*) On no account will hot water be used, nor the feet held near a fire.

(*e*) Where possible, hot food will be provided during tours of duty in the trenches.

(*f*) Where circumstances admit, long gum boots will be put on while the men's feet are dry before entering wet trenches, in order that men may start their tour of duty with dry feet.

(*g*) When gum boots are worn it is well to support the socks by some form of fastening such as a safety-pin, to prevent them from working down the heel. On no account will anything in the form of a garter be worn.

(*h*) Where conditions are favourable, regimental rest posts will be instituted in proximity to the trenches, where men who show signs of suffering from exposure can be promptly attended to.

5. Under brigade arrangements, provision will be made for the washing and drying of feet in reserve billets, for the exchanging of wet socks for dry ones, and, if possible, the sending of the latter to the trenches, and for drying and brushing clothes. Steps will be taken to ensure that men make use of these arrangements.

6. Long gum boots are being issued to the fullest extent of the supply available, and every effort will be made to procure all that are necessary for men holding waterlogged trenches. It is pointed out that the distribution of these boots depends upon the necessity for their use according to the nature of the trenches held by divisions, brigades, etc., and that, therefore, the distribution will be made not according to the numerical strength of formations, but according to the nature of the trenches which formations are required to hold.

APPENDIX VIII

SCHEME OF SANITARY ORGANIZATION WITH A FORCE OF ONE ARMY IN THE FIELD

Formation. Unit or Area concerned	Representative of the Medical Services.	Specialist Adviser in Hygiene and Sanitation.	Special Sanitary Units or Personnel.
G.H.Q. ..	Director of Medical Services.	Assistant Director of Hygiene	Sanitary Sections, Mobile Laboratories, Schools of Instruction.
Corps	Deputy - Director of Medical Services.	Deputy - Assistant Director of Hygiene.	Sanitary Sections, Schools of Instruction.
Division ..	A.D. of M.S.	D.A.D. of M.S.	Sanitary Section.
Detached Brigade	A D.M.S. of Division or delegated to S.M.O.	——	——
Unit ..	Officer in medical charge.	——	Regimental Sanitary Detachments and Water Detachments.
H.Q., L. of C. Area	Administered	from G.H.Q.	
L. of C. { Base, Railhead, Sub-area, Post, &c.	A.D. of M.S. or S.M.O.	Deputy - Assistant Directors of Hygiene, Sanitary Officers, Commanders (if medical) of Sanitary Sections.	Sanitary Sections, Unit Sanitary Detachments, Base and Local Laboratories, Schools of Instruction.

NOTES:—1. S.M.O.—The senior representative of the medical services in the area or formation.
2. Os. C. sanitary sections are not necessarily medical officers.
3. The services of expert advisers may be utilised by the Director of Medical Services either individually (chemists, entomologists, geologists, &c.) or collectively as an Advisory Hygiene Committee

APPENDIX IX

USEFUL DATA

Measures of length:—

12 inches = 1 foot; 3 feet = 1 yard; 1,760 yards = 1 mile.
1 metre = 39⅓ inches (approximately).
8 kilometres = 5 miles.
100 links = 1 chain = 22 yards = 66 feet.
A fathom = 6 feet.
10 nautical miles = 11½ miles (approximately).
Diameter of a half-penny = 1 inch.

Measures of area:—

144 square inches = 1 square foot; 9 square feet = 1 square yard; 4,840 square yards = 1 acre.
1 square metre = 1·2 sq. yards = 10·8 square feet.
100 square metres = 1 are; 10 ares = ¼ acre (approximately).
An acre = 70 yards × 70 yards (approximately).

Cubic measures:—

1,728 cubic inches = 1 cubic foot; 27 cubic feet = 1 cubic yard.
1 cubic metre = 1·3 cubic yards.
1 cubic foot = 6¼ gallons (approximately).
1 cubic metre = 220 gallons.
40 cubic feet = 1 ton (shipping).

Measures of capacity:—

20 fluid ounces = 1 pint; 2 pints = 1 quart; 4 quarts = 1 gallon.
1 litre = 1¾ pints (approximately).
1 gallon = 4½ litres (approximately).
1 gallon = 277½ cubic inches (approximately).
A tablespoonful = ½ fluid ounce (approximately).

Measures of weight:—

16 ounces = 1 lb.; 112 lbs. = 1 cwt.; 20 cwts. = 1 ton.
1 kilogramme = 2·2 lbs.
1 lb. = 7,000 grains; 14 lbs. = 1 stone.
12 pennies = 4 ounces (approximately).

Measures of time:—

60 seconds = 1 minute; 60 minutes = 1 hour; 24 hours = 1 day.
One degree of longitude = 4 minutes in time.
One hour = 15 degrees of longitude.

Measures of temperature:—

Centigrade scale: Freezing point=0°C.: Boiling point=100°C.

Fahrenheit Scale: Freezing point=32°F.: Boiling point=212°C.

To convert Fahrenheit to Centigrade: Deduct 32 and multiply remainder by 5/9. To convert Centigrade to Fahrenheit: multiply by 9/5 and add 32.

Mensuration:—

Area of a square=square of the side=$\frac{1}{2}$×square of the diagonal.

Area of a rectangle=length× breadth.

Area of a triangle=base×perpendicular height×$\frac{1}{2}$.

Area of a circle=square of the radius×π.
=square of diameter×$\pi/4$.

Content of a cube=cube of the length of one side.

Content of a rectangular solid=length×breadth×height.

Content of a cylinder=area of base×height.

Content of a sphere=cube of diameter×$\pi/6$.

$\pi=3\cdot1416=3\frac{1}{7}$ (approximately).

$\pi/4=0\cdot7854=\frac{11}{14}$ (approximately).

$\pi/6=0\cdot5236=\frac{11}{21}$ (approximately).

Triangles with sides in the following ratios are right-angled, the right angle in each case being opposite the longest side:—

3	:	4	:	5
5	:	12	:	13
8	:	15	:	17

Water supply:—

One gallon of water weighs 10 lbs.

Capacity of the regimental water cart=110 gallons.

Water supply in barracks=20 gallons per head per day.

For watering roads, &c., allow $\frac{1}{3}$ gallon per square yard.

Average velocity of a stream=$\frac{4}{5}$ of surface velocity.

Rainfall in inches×$\frac{1}{2}$ area in square feet=gallons (approximately).

Ventilation:—

Average requirements=1,000 cubic feet of fresh air per head per hour.

An air velocity of 3 feet per second is a perceptible draught.

Atmospheric pressure=15 lbs. per square inch (approximately).

Suitable Katathermometer readings for indoors are:—Dry kata=6, wet kata=18.

Accommodation:—(*See* also Appendix II).

Offices and regimental shops should give 40 square feet of floor space and 400 cubic feet of air space per head.

Glass area of windows = $\frac{1}{10}$ floor area of apartment.

Latrines in barracks = 6 seats per 100 men, and 4 urinal stalls per 100 men.

Dining rooms = about 8 square feet per head.

Kitchens = from $2\frac{1}{2}$ to 3 square feet per head cooked for.

Constructional :—

Mortar = lime 1 part, sand 3 to 4 parts.

Concrete = gravel 9 parts, sand 3 parts, cement 1 part.

Bricks (with mortar) = $9 \times 4\frac{1}{2} \times 3$ inches.

Greatest depth for a temporary vertical face:—moist sand = 3 to 6 feet; earth 3 to 6 feet; clay 10 to 16 feet.

Average weights per cubic foot :—

Brickwork = 112 lbs. : deal = 43 lbs.

Concrete = 120 lbs. : oak = 54 lbs.

APPENDIX X

METHOD OF USING PEAS, LENTILS, BEANS, OR OTHER PULSES (DHALL) FOR THE PREVENTION OF SCURVY, IN THE ABSENCE OF FRESH VEGETABLES

(1) The dry seeds must be whole, retaining the original seedcoat, not milled or decorticated.

(2) They must be soaked in water for several hours ; the time necessary depends on the temperature, twenty-four hours at 50° F. to 60° F., and twelve hours or less at 90° F.

(3) The water must then be drained away, and the peas, beans, etc., allowed to remain in the moist condition with access of air. They will then germinate and the small rootlet grow out. This germination will take forty-eight hours at 50° F. to 60° F., and twelve to twenty-four hours at 90° F.

(4) The operations described in (2) and (3) could conveniently be done under active service conditions in such manner as the following :—

Soaking.—The peas, beans, or other pulses, placed in a *clean* sack, should be steeped in a trough, barrel, or other suitable vessel, full of clean water, and should be occasionally stirred. The sack and trough, etc., should be large enough to allow for the swelling of the peas to about three times their original size. In a hot climate six to twelve hours should suffice for this soaking.

Germination.—The peas should be lifted out of the water and spread out to a depth not *exceeding two to three inches* in a trough or other vessel with sides and bottom porous or well perforated with holes. This is to allow complete access of air. *The seeds must be kept in a moist atmosphere.* This is done by covering with damp cloth or sacking, which is sprinkled (by hand or automatically) as often as is required to keep the peas or beans thoroughly moist underneath. The germination should reach the stage mentioned in (3) above within twenty-four hours in a hot climate.

All the vessels should be clean.

(5) It is important that the germinated pulses should be cooked and eaten as soon as possible after germination, and should not be allowed to become dry again, as in that case the anti-scorbutic properties, acquired during the process of germination, will again be destroyed. The pulses should not be cooked longer than necessary, and in no case for a longer period than 15 minutes.

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